Railway Mechanical Engineer

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INDEX TO VOLUME C

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U

V

W

Y

Z

APPOINTMENTS OF RAILWAY OFFICERS

OBITUARY

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SUPPLY TRADE NOTES

* Illustrated

* Illustrated

Railway Mechanical Engineer

Volume 100 JANUARY, 1926 No. 1

Table of Contents

Have you seen "The Reader's Page" on page 59? We hope you will make full use of it in future issues.

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Railway Mechanical Engineer

Vol. 100 January, 1926 No. 1

Readers of the *Railway Mechanical Engineer* who have found matters of interest to them in the department entitled "What Our Readers Think" need not be disappointed when they fail to find it in the accustomed place immediately following the editorials because this does not mean that the department has been discontinued. For some time an increase in the interest our readers have taken in this department has been evident and the number of letters we have received for publication has been so great that at times we have been embarrassed to print them promptly in the subordinate position the department formerly occupied. Therefore, in order better to serve this interest, a "Readers' Page" has been established, following immediately at the close of the "Shop Practice" section. As the title indicates, this page—and more if necessary—belongs peculiarly to our readers. It is open to seekers for information on points of practice or other matters bearing on mechanical department affairs. It is open to those who will supply this information. It is also open to those who have opinions on any matters of interest to mechanical department officers and supervisors which they may not be prepared to present in the more formal manner implied by an article for one of the other departments, but of which they still wish to be unburdened. With a cordial invitation to use it, the editors place this department in the hands of the readers.

The readers' page

Railroad shops have, from time to time, been the object of criticism by some who would comment upon their relative "inefficiency" as compared with modern industrial plants. To endeavor to make a direct comparison between the two as a whole is to attempt something the ultimate success of which is doubtful. The industrial plant is, as a rule, engaged in a class of work which lends itself to the efforts of the production engineer. Production depends on the demand for the product and, once this demand is established, given the necessary supply of raw materials, the whole job can be planned with exactness and carried through to completion. In comparison, it is extremely difficult to forecast with any degree of certainty the demand for the "product" of the railroad shop. Even granting this possibility there is one disturbing element that the railroad shop has to contend with—the emergency job. There is one basis of comparison, however, between the railroad shop and the industrial plant which is not only worthy of serious thought but which railroad shop supervisors can ill afford to ignore. That is the element of unproductive man-hours. Time studies in industrial plants have done much to eliminate idle time, principally because the time-study records have played up the enormous losses and evidenced the necessity for careful planning. The locomotive shop scheduling system and the progressive car repair system are outstanding examples of efforts to eliminate idle time by careful planning. And it is not unreasonable to hope that, by a scientific study of methods and an intelligent classification of repair work, the "emergency job" may at least be isolated to such an extent that its effect on routine shop work will be negligible. Within the past two or three years many large repair shops have inaugurated production methods with such highly successful results that there can be no doubt as to the value of scientific planning and its adaptability to railroad shop work. It eliminates idle time, reduces the burden of supervision, anticipates delays and minimizes material shortages. These factors are all reflected in a lowered cost for maintenance of equipment.

Is your shop on a schedule?

Probably not a car foreman in the country, and certainly few railroad operating men, will dispute the statement that the proper inspection of cars requires expert judgment on the part of experienced car inspectors. Nevertheless, relatively few of these same car foremen are carrying on, to the extent desirable, educational work with their car inspectors or among the men from whom the future car inspectors will be selected. It is too generally assumed that a man with a few years experience on the "rip track," a limited knowledge of the interchange, safety appliance and loading rules and the ability to copy car numbers is fitted to become a car inspector.

The car inspector's judgment

Yet upon this man, picked without adequate consideration of the requirements of the position to which he is assigned, rests the authority to delay traffic by the mere act of applying a bad order card, or to pass upon an empty car intended for movement across the continent of a valuable and easily damaged commodity. This is the man who, in the exercise of his judgment, moves or delays the traffic of the country; for, as was pertinently said at the December meeting of the Chicago Car Foremen's Association, the car inspector's authority exceeds in certain respects that of the superintendent and other higher railroad officers. After the traffic department, for example, has solicited a shipment, the agent furnished a car, the yard forces placed it for loading and then put it into a train, and the transportation department rushed it over the road, up steps a car inspector at an intermediate point and applies a bad order card. The efforts of the other departments to expedite the movement have gone for naught. The result is a disgusted shipper and a disgruntled consignee, all because the car inspector has exercised his judgment. If his judgment is poor the shipment has been unnecessarily delayed; if it is good he has protected the movement of the shipment and other property.

There is no employee on American railroads to whom more attention should be paid, upon whom more edu-

cational effort should be extended, for whom more incentives should be provided, than the car inspector.

The mere act of examining a man superficially will not suffice. Definite standards must be set, means provided for attaining these standards and frequent practical tests conducted by someone thoroughly familiar with the requirements, to check up each step of the progress made.

Water rises no higher than its source; and an inspection organization can advance no farther than the knowledge, training and ability of the individual inspectors will permit. Improve the car inspector's judgment by careful training and frequent checks.

Control of workmanship in welding

Probably no process among the many metal working and forming processes employed in the railroad shop depends for the success of its application so completely on personal skill and fitness as does the autogenous welding process. Like all other processes, it is true that many of the requirements for satisfactory and reliable results are of a perfectly tangible nature, controlled by ordinary methods of supervision. Some of these factors are the selection of size and composition of welding wire, the selection of current value in the case of electric welding, or the character of the flame in the case of gas welding, the preparation of the surfaces of the pieces to be joined and proper design of the weld. But after a knowledge of these and other similar factors has been acquired and applied through systematic methods of supervision, there is still left one of the biggest factors in the success of the results—the personal skill and adaptability of the welder.

In most other shop processes, the quality of workmanship can usually be determined by surface inspection of the work after its completion or by other equally tangible means. In autogenous welding, however, even though much supervisory skill has been developed, the shortcomings of the workman are, to a relatively large extent, concealed. The problem of workmanship control is, therefore, to effect some means of determining in advance of performance what will be the quality of the workmanship. There is a growing appreciation of the importance of this difficult problem and its solution in being attacked vigorously in the industries, as well as on some railroads. Elsewhere in this issue will be found an article describing a system of operator control developed primarily for the industrial application of welding which, however, should be highly suggestive of what can be done along similar lines under railway shop conditions. Perhaps the two most important points in this article are the suggestions with respect to training operators—never taking for granted that because a man has proved reliable on one class of work he may be entrusted with another without undergoing special training to meet the changed conditions of the new job—and the other is the development of a systematic and periodical check of each operator's workmanship by means of sample welds, the quality of which may be determined by testing to destruction, either in the shop or the laboratory, or preferably both.

The autogenous welding processes have been the means of effecting remarkable savings in the costs of performing many jobs in the railroad shop. In the developing of the art the processes have been applied in some cases to jobs for which apparently they were not adapted, but if the application of the processes can be brought to a sufficiently high state of perfection, they might still be found to be thoroughly adapted to some of these jobs. Such a state of perfection, however, can only be obtained when all elements of the process are brought thoroughly under control and not the least important of these elements is the quality of workmanship. This can only be insured, first, by the temperamental fitness of the welder, second, by thorough training under each set of conditions before employment on important work, and third, by the frequent and systematic checking of the workman's skill and the quality of his performance by testing sample welds.

The younger men

Few developments in the railway field in recent years have made a greater appeal to the average railway officer or foreman than the movement to help the younger men "find themselves" and to develop along the right lines. This was started in a large way two years ago at St. Louis, under the direction of the Railroad Y. M. C. A., and in connection with its triennial convention. That organization had been giving more or less thought to the needs of boys and younger men in railroad service for a number of years, and several experiments had been tried out at different points on a smaller scale. The first national gathering of the younger men at St. Louis was comparatively small and in the nature of an experiment. It proved so fruitful, however, that a second meeting was held at Detroit a year later. It proved to be a great success, because of the long and painstaking efforts of the local organization of railroad men in developing the plans, and the co-operation of boys' work experts from both the local and the national organization of the Y. M. C. A. Inspired by this meeting, the Chesapeaks & Ohio held a system younger men's conference along similar lines. Naturally, on the basis of these three conferences, it was possible to improve greatly the technique of handling conferences of this kind, and the national conference held in Pittsburgh last November proved to be very much more effective than any of those which preceded it. Moreover, there is every reason to believe that the Pittsburgh conference will be followed up in the local fields and the inspiration which was started there conserved in a far greater degree than for the preceding national conferences.

One striking illustration of this was the second annual Christmas banquet of the apprentices on the Missouri-Kansas-Texas at Parsons, Kan. The young men reproduced the high spots of the Pittsburgh meeting in a sort of "mock conference." One of the principal features of the national conferences is the filling out of certain blanks by the young men. indicating what kind of work they would like to be engaged in ten years from now and why they think they are fitted for it. On the basis of these reports, small groups of the younger men are assigned for advice and counsel to practical railroad officers who are best fitted to help them. In addition to the reproduction of the high spots in the important addresses at the Pittsburgh conference, the "mock conference" at Parsons reproduced these vocational counseling groups with excellent results. It is significant, also, that at the Parsons meeting several of the general officers of the railroad, including Vice-President Whitenton and Mechanical Superintendent Warden, were present and made short addresses.

The delegates from other roads at a number of local points have carried much of the inspiration of the conference back to their fellows, and this is resulting in the formation of a number of American Railway Employed Boys' Clubs, or similar organizations. In general, these clubs aim to encourage the boys along educational, physical, social and spiritual lines and to make them better citizens. It is significant, also, that several of the railroad clubs, inspired by the Younger Railroad Men's Conferences, have inaugurated "Younger Men's Nights" and are doing much to stimulate a greater interest among railroad officers and foremen in encouraging the younger men and

helping them better to prepare themselves for their life work and to fit themselves for better positions. It is difficult to estimate the great value of this development which is steadily growing in size and force. Taken in connection with the increasing number of modern apprenticeship systems in the mechanical departments of the railways, it promises to do much to insure the right kind of men and leadership for the future.

Monorail vs. power truck

Monorail material handling systems, equipped with electric, pneumatic, or chain hoists are used extensively in railroad shops and enginehouses for the transportation of heavy parts from one department to another, or from one machine to another. They are great labor savers as are also the gas or electric power trucks with jib crane attachments which are becoming increasingly popular with railroad men because of their flexibility and the fact that they can get from one place to any other quickly and lift a load from almost any position. A recent editorial in a foreign railway paper commenting on these two forms of intershop communication somewhat to the disparagement of the electric truck with jib crane attachment, brought the following comment from an American general superintendent of motive power: "The truth of the matter is that the electric trucks are invaluable. Our first equipment of this sort is in operation at G——— and it is surprising what can be accomplished with it. I really don't think the average railroad outside of probably the X. Y. Z. (mentioning a railroad which has been a leader in the use of labor-saving shop equipment), appreciates the preference of these electric trucks to the monorail."

A careful analysis of the matter will undoubtedly show that the monorail system, with the particular type of hoist best adapted to individual needs, has its own special field of usefulness; the power truck, whether electrically or gasoline motor-operated, and whether used as truck or tractor, has another important field of usefulness; and for still other conditions, the power truck with jib crane attachment is by far the best adapted.

It is not difficult to get enthusiastic about the modern power truck as used in railroad shops and enginehouses. It is ruggedly built, powerful, economical in use and upkeep, and easy to operate. The particular electric truck referred to by the general superintendent of motive power was operated by an inexperienced man after 10 min. explanation of the functions of the various operating handles. At the end of the day, according to the testimony of the shop foreman, this man was apparently operating the truck as carefully and as well as the manufacturer's representative.

It may be said that the electric truck, while having ample power, is not a "mud horse," or a "mountain goat." Largely on account of the small diameter wheels, it requires hard, smooth passageways for efficient operation. With the crane attachment, it will handle a locomotive boiler front, smoke stack, bell, air compressor, feed water heater, main rod or piston with equal ease. The older railroad mechanic who remembers how he had to rig up a "sky hook," staging, or platform and chain falls, and then look up four or five helpers to assist in removing some of these parts from locomotives, finally hauling the parts laboriously on a two-wheel truck through the shop or enginehouse, is duly appreciative and thankful for the modern power-operated truck which saves so much of time and hard, dangerous manual labor. The master mechanic, shop superintendent and mechanical department head also are appreciative, for they can readily trace the influence of the power truck in reducing locomotive and car material handling costs and, moreover, materially speeding up the time when equipment can be returned to service.

Nineteen twenty-five

During the year 1925 the railroads handled a large, but not record-breaking, traffic; they placed orders for a comparatively small number of locomotives and freight cars and a few less passenger cars than were placed on the average during the previous three years; their purchase of machine tools and shop equipment varied but slightly from those made during the preceding year, and present indications are that they will continue on about the same basis during 1926. The operating statistics for the railroads of the United States indicate a splendid locomotive performance and a continuance of the satisfactory equipment conditions which obtained during 1924. In these two features of the year's operation, the mechanical departments of the railroads have reason to feel a large measure of satisfaction in that they have had no small part in the splendid record for effective service and efficient performance which characterized the 1925 railway operations.

During the year Railway Age statistics show that orders for 1,065 locomotives were placed for service in the United States and Canada, which compares with 1,484 in 1924; 2,026 in 1923, and 2,668 in 1922. The orders for freight cars for service in the United States and Canada numbered 93,458, which is the first year since 1921 in which the number of cars ordered has been less than 100,000. Orders for 2,241 passenger cars were placed for service in the United States and Canada, and while there has been a less marked recession here than in the case of either locomotives or freight cars, the orders still are the smallest which have been placed since 1921; the figures for the three preceding years are 2,469 in 1922; 2,477 in 1923, and 2,654 in 1924. An indication of the growing field for the rail motor car is found in the fact that 149 cars of this type, including trailers, were ordered in 1925, as compared with 120 in 1924, 76 in 1923, and 51 in 1922.

Elsewhere in this issue will be found a list of the machine tools and shop equipment purchased by the railroads during 1925, this being the second year that information on this subject has been available. The interesting fact in the machine tool and shop equipment market situation is the insignificant variation in the amount of equipment purchased last year, as compared with 1924, and the fact that the budget information available indicates that there will be little variation in the amount of equipment purchased during 1926. Comparing this with the orders for equipment, there is evidence of a degree of stability in the shop equipment market which is lacking in the other, although it is worthy of attention that the two years for which these data are available have not covered a sufficiently wide range of railroad business conditions to indicate clearly what effect, for instance, a large increase in traffic might have in increasing shop equipment expenditures.

During 1925 no marked change in the condition of equipment has taken place, although the tendency with respect to locomotives has been toward improvement. During the ten months of the year for which the data are available, the percentage of unserviceable to total locomotives in freight service was reduced from 18.8 for 1924 to 18 per cent for 1925. In the case of passenger locomotives, the same condition holds, with the reduction from 18.5 to 18 per cent. Freight car conditions have remained practically unchanged, the per cent unserviceable to total cars on line having averaged 7.8 per cent for the first 10

months of 1924 and 7.9 per cent for the same period of 1925.

What is of particular interest, however, is the increasing service which apparently has been obtained from the locomotives actually in use during 1925 and the efficiency with which this service has been rendered. The average freight train loads during the months of heaviest traffic in 1925 were materially larger than they have ever been before. The average freight train speed has also continued the tendency to increase which has been evident for the past two or three years. The combined result of these two factors was an increase of about 1,000 gross ton-miles per train-hour in the average freight train performance of the country during the months of heavy traffic in the fall of 1925, with something more than 20,000, as compared with similar months of 1924 with something more than 19,000. Average train loads since July have exceeded 1,700 tons, exceeding by 75 to 100 tons the average train loads during similar months of the previous year. No doubt, the larger train load is to a considerable extent a reflection of the increasing tractive force of locomotives in freight service. It is also, no doubt, partially the result of better train loading, although it is evident that this was not carried to a point of overloading because during the peak traffic of October, which shows the largest movement of gross-ton miles of any month recorded, the average freight train speed was 11.6 miles per hour, as compared with 11.4 miles per hour in October, 1924, during which month the total traffic movement was less. The miles per day per locomotive owned increased from 60.8 in October, 1924, to 65.5 in October, 1925, and the miles per day per locomotive reported in actual service increased from 84.4 miles per day in 1924 to 89.9 miles per day in 1925. In this performance an increase in locomotive utilization is indicated.

Attention should also be called to the fuel performance, in which officers and employees of the mechanical department have had no small part. For the first 10 months of 1925 the freight traffic of the United States was moved with an everage of 138 lb. of coal per 1,000 gross ton-miles. It took 148 lb. of coal to perform the same service during the same period of 1924. Similarly, in passenger service, the fuel consumption per passenger train car-mile was reduced from 16.8 lb. during the 10 months' period of 1924 to 16 lb. in 1925.

During the first 11 months of the year for which actual data are available, there was an actual decrease both in the number of locomotives and in the aggregate tractive force on the railroads in the United States, although in those regions where material traffic increases took place, the aggregate locomotive tractive force increased. For the country as a whole all the statistical data bearing on railroad performance affected by equipment utilization and equipment conditions all show that the situation has been eminently satisfactory, for which mechanical department officers and employees should receive the full measure of credit due them.

New Books

TRAINING KEY-MEN IN INDUSTRY. Report No. 75, Policyholders' Service Bureau, Group Insurance Division, Metropolitan Life Insurance Company, New York.

This pamphlet (8½ in. by 11 in., 20 pages), contains a number of important suggestions which will be of value to railroad supervisors who are interested in training for better leadership. In discussing the topic, "The Foreman Plays an Important Part," the report contains the following significant paragraph.

"In all probability few foremen appreciate what important factors they are in the lives of those whom they supervise. If the day begins with a snarl from the boss, if the atmosphere is tense, if inefficiency and chaos prevail, it inevitably follows that work is performed unwillingly and carelessly, for the pleasure of working with a team and working well has been destroyed. The men themselves may not know why life is dull or why they do not like to work in a certain shop or plant. The foreman, meanwhile, being unconscious of the nature and power of his influence, thinks his men uncommonly stupid and ill-dispositioned, while the production records tell the results of friction.

"Obviously, certain characteristics such as leadership, self-control, initiative and tact are needed for good foremanship. These qualities are born in men, but much can be accomplished through training to develop them, and thus the ability to bring forth men's best efforts."

The report discusses first the several requirements of a good training course, which are listed as follows: (1) The management must have a progressive attitude and a sincere desire to share its knowledge and responsibilities with the foremen; (2) the leader or the instructor of the classes must know his subject and be able to put it over with the men; (3) the group of foremen must be carefully selected; (4) the material presented in the course must meet a real vocational need. Each of these points is amplified and other requisites are also mentioned.

In discussing what to teach the foremen, special reference is made to a report of the Federal Board for Vocational Education in Bulletin 36, of the Trade and Industrial Series No. 7. This presents a complete course of foreman training, which can be adapted to specific industries or plants. Mention is also made of the course of study prepared by the Business Training Corporation, and outlines are given of the United Y. M. C. A. Schools course in foremanship, and also of a course prepared by the University of Wisconsin.

Three methods of training foremen are discussed, including the lecture method; the text study method, which is usually combined with lectures or informal conferences; and the group conference method, which is best adapted to groups of 12 or 15 men.

Other questions which are discussed in the report include the cost of foreman training, how to set up foreman training, a statement of accomplishments in a number of industrial plants, and a short bibliography, including a few books, several articles in publications and a number of conference reports. An appendix contains an outline of the foremanship training course of the Submarine Boat Corporation at the Newark Bay Shipyard.

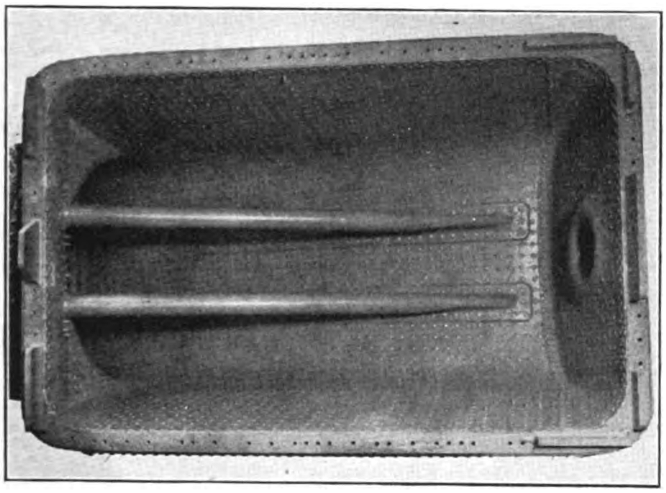
MASTER BLACKSMITHS' PROCEEDINGS. *Edited by William J. Mayer, secretary, Detroit, Mich. 127 pages, 5½ in. by 8 in. Bound in cloth. Illustrated.*

The report of the twenty-ninth annual convention of the International Railroad Master Blacksmiths' Association held at the Hotel Winton, Cleveland, Ohio, August 18, 19 and 20, 1925, contains many papers which are of interest and value to blacksmith foremen and others interested in the work of the blacksmith shop. Besides the regular business reports of the association, the book contains reports and papers on such subjects as autogenous welding, carbon and high speed steel, drop forging, frame making and repairing, heat treatment of iron and steel, reclamation and tools and formers. The various papers and reports have been carefully edited by the secretary, Mr. Mayer, and the arrangement of the contents is such that any information desired is easy to find.

Texas & Pacific 2-10-4 locomotives

Engines, known as Texas type, have four-wheel articulated trailer—Tractive force with booster, 96,000 lb.

THE Texas & Pacific has recently received 10 locomotives from the Lima Locomotive Works, Inc., which are the first to be built with a 2-10-4 wheel arrangement. These locomotives are known as the Texas type, and are similar in the principal characteristics of their design to the Lima A-1 first placed in service on the Boston & Albany early in 1925 and since tested on several other roads. Both designs include the articulated four-wheel trailing truck carrying a large firebox; both have articulated main rods, and the cylinders in both cases operate at a maximum cut-off of 60 per cent. The new locomotives, however, have one more pair of driving wheels, making a 2-10-4 wheel arrangement, which increases the length of the boiler and the tractive force.



The fire-box is equipped with Nicholson thermic syphons

They also differ from the Lima A-1 in that they are fitted for oil-burning service.

The new locomotives have a total engine weight of 448,000 lb., of which 300,000 lb. is on the driving wheels. With a boiler pressure of 250 lb. and 60 per cent cut-off, they develop a tractive force of 83,000 lb., which is increased to 96,000 lb. when the trailer booster is in operation. A comparison of these and other of the principal dimensions, with similar dimensions of the Lima A-1, is given in the table.

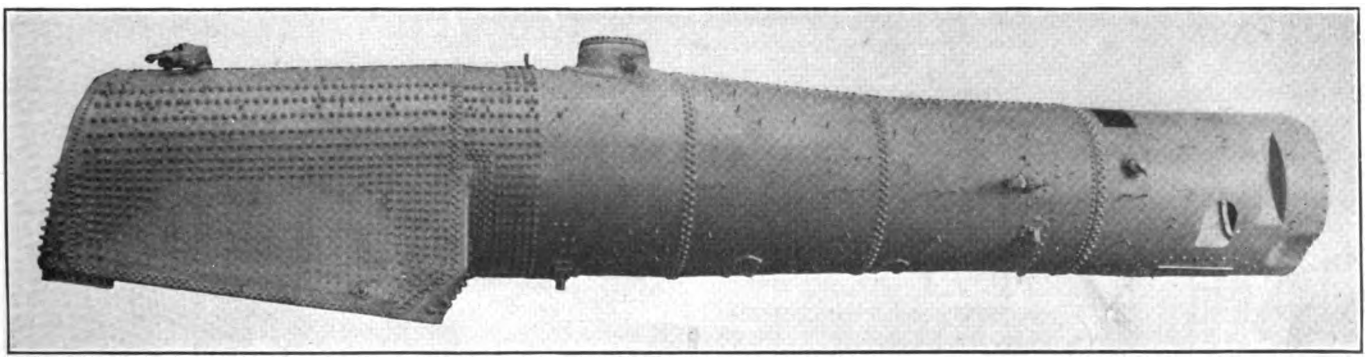
Referring to this comparison, it will be seen that the weight on drivers of the new type locomotive averages 60,000 lb. per pair, which is 2,000 lb. less than the average driving wheel loads of the Lima A-1. The weight on both the front and rear trucks, however, is greater than in the case of the former locomotive, the total difference in weight amounting to 63,000 lb.

A comparison of the boiler proportions of the two designs is also of interest. While in total evaporating heating surface and superheating surface the new locomotives differ but slightly from the A-1 locomotive, there is a material difference in the distribution of the evaporating heating surface as between the firebox and tubes. The tubes and flues in the new locomotives are 1 ft. 6 in. longer than those in the earlier locomotive, but are fewer in number, accounting for the reduction in the amount of tube and flue heating surface. The firebox, however, including the combustion chamber and the two Nicholson thermic syphons, has a materially larger amount of heating surface, the proportion of firebox heating surface to evaporative heating surface thus being increased from 6.6 per cent in the Lima A-1 to 9.26 per cent in the new locomotives, a difference which, on the basis of Cole's ratios, would account for approximately 10 per cent more evaporating capacity. The increase in cylinder tractive force from 69,400 lb. to 83,000 lb. amounts to about 19

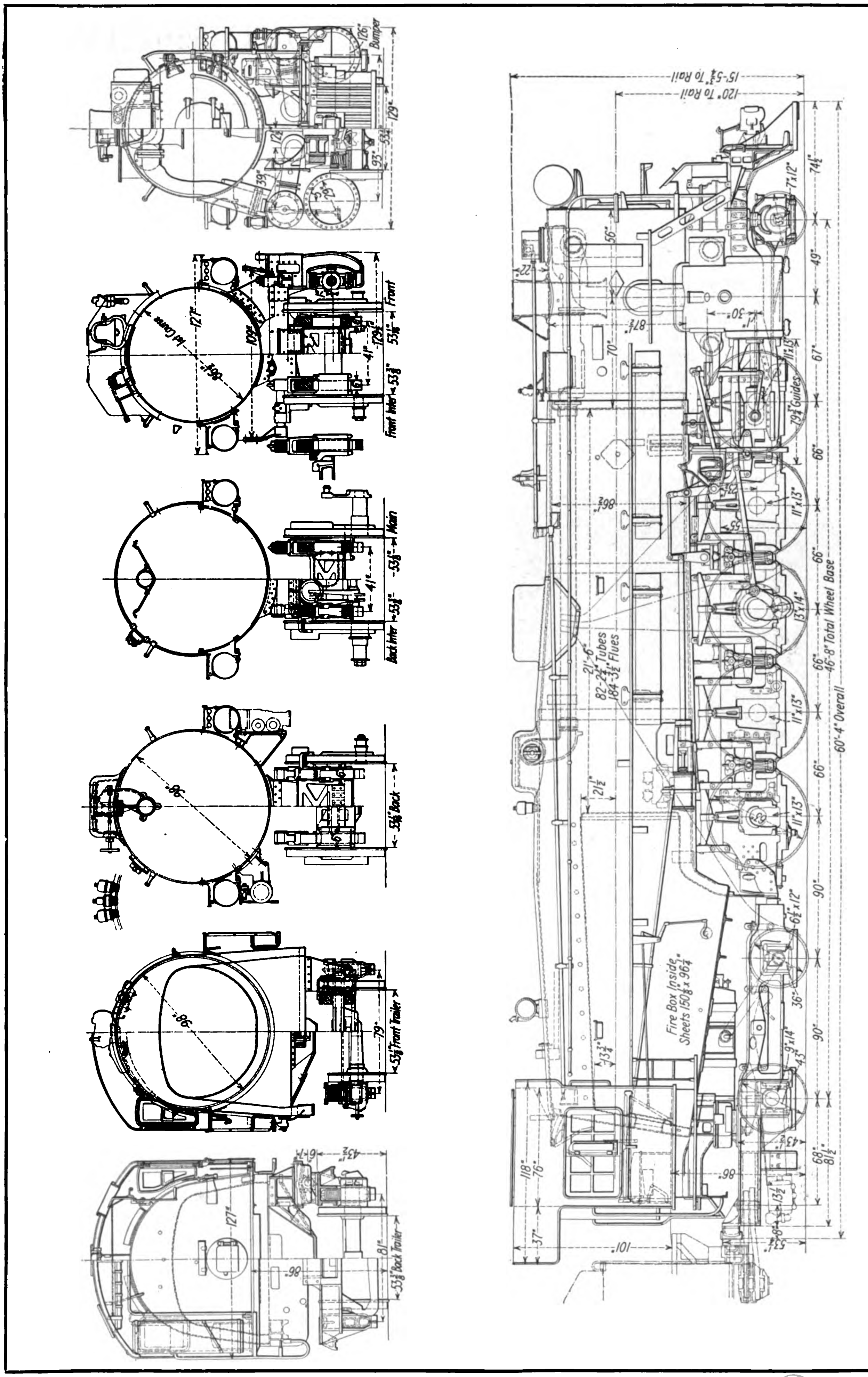
Comparison of Texas & Pacific 2-10-4 locomotives with Lima 2-8-4 locomotive

	2-10-4	2-8-4
Cylinders, diameter and stroke, in.	29 by 32	28 by 30
Cut-off in full gear, per cent	60	60
Boiler pressure	250 lb.	240 lb.
Weights in working order:		
On drivers	300,000 lb.	248,000 lb.
Front truck	41,800 lb.	35,500 lb.
Rear truck	106,200 lb.	101,300 lb.
Total engine	448,000 lb.	385,000 lb.
Diameter of drivers	63 in.	63 in.
Heating surfaces:		
Firebox and combustion chamber	473 sq. ft.	337 sq. ft.
Tubes and flues	4,640 sq. ft.	4,773 sq. ft.
Total evaporating	5,113 sq. ft.	5,110 sq. ft.
Superheating	2,100 sq. ft.	2,111 sq. ft.
Combined total	7,213 sq. ft.	7,221 sq. ft.
Grate area	100 sq. ft.*	100 sq. ft.
Rated tractive force:		
Engine	83,000 lb.	69,400 lb.
Engine and booster	96,000 lb.	82,600 lb.
Factor of adhesion	3.62	3.58

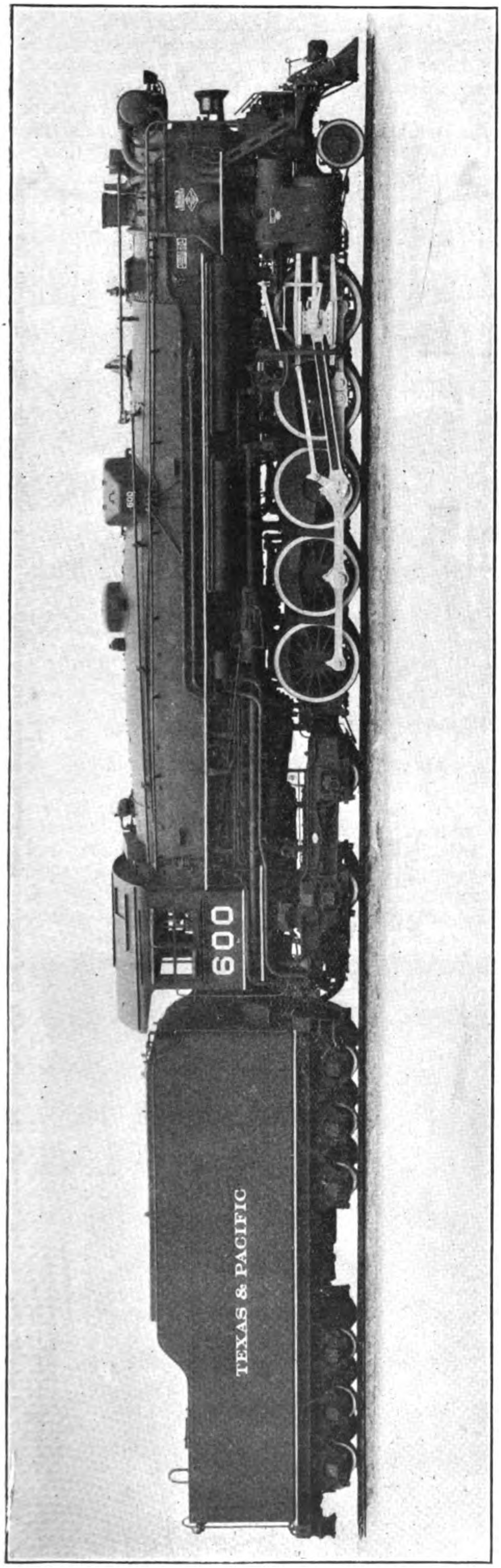
* The firebox is fitted for burning oil.



The boiler—The fire-box measures 150⅛ in. by 96¼ in. at the mud ring



Elevation and cross sections of Texas & Pacific 2-10-4 type locomotives



The total weight of this engine is 448,000 lb., the weight on drivers, 300,000 lb.—The articulated trailer carries 106,200 lb.

per cent. The Texas type locomotives will be assigned to the Ft. Worth and Rio Grande divisions between Marshall, Tex., and Big Springs, a distance of 450 miles. The ruling grades on these divisions approximate 1.5 per cent and extend from five to eleven miles in length. Heavy curvature is encountered, making necessary the use of the booster in ascending the heaviest portions of these grades.

The boilers of the new locomotives, aside from the increase in length made possible by the increase in the wheel base, differ principally from the boiler of the A-1 locomotive in the inclusion of a 42-in. combustion chamber, in the location of the dome just in front of the combustion chamber, and in the use of an inside dry pipe. It will be remembered that the dome in the earlier locomotive was located on the front boiler course, with a short outside dry pipe. The dome course in the new boilers is 98 in. in outside diameter, this being reduced by a taper course to 86½ in. at the front course. A shut-off valve, by which the entrance to the dry pipe may be closed, is located in the dome, the operating handle extending out through the right side of the dome. The tubes are 21 ft. 6 in. long and the tube sheets are laid out with 184 flues 3½ in. in diameter, for a Type E superheater of 92 units. With the exception of the change in the dry pipe, the front end arrangement is essentially the same as that of the Lima A-1. The unit bolts of the superheater header are accessible through a rectangular opening in the top of the smokebox shell and the Chambers front end throttle is located between the superheater header and the branch pipes forward of the smoke stack.

The firebox, which has the same inside dimensions at the mud ring as the Lima A-1, is fitted for oil-burning service, with a 4-in. Booth burner entering the front of the draft pan which is set back about one-third the length of the firebox from the front of the mud ring. The locomotive is designed, however, for possible later conversion to coal-burning service, in which case the two Nicholson thermic syphons will serve as arch supports.

The locomotives are fitted with an Elesco feedwater heater carried on brackets on the front end. The feedwater pump is located under the running board on the left side of the locomotive.

Cylinders, frames and running gear

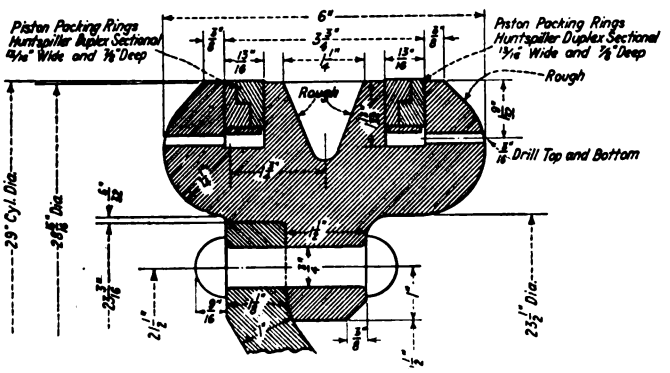
The cylinders are 29 in. in diameter by 32 in. stroke. They are steel castings with Hunt-Spiller gun iron bushings and, like the cylinders of the Lima A-1, the exhaust steam is carried from extension valve chamber heads through cast pipes which are bolted to openings on the front and back faces of the saddle casting, from whence the exhaust steam is carried inward and upward through cored passages to the exhaust nozzle base at the top of the saddle. These are the only steam passages in the saddle portion of the cylinder castings. The exhaust nozzles are fitted with tips having the Goodfellow internal projections.

This cylinder construction is shown clearly in one of the illustrations. It has made possible a reduction of the metal sections such that a saving of approximately 4,000 lb. has been made in the weight as compared with equivalent cast iron cylinders.

The valve chamber bushings are fitted with the usual auxiliary starting ports necessary where the locomotive is to operate at a limited maximum cut-off, and in order to effect the maximum attainable smoothness of starting torque the cut-off at the front end of the cylinder is increased to 63 per cent at starting and slow speeds by lengthening two of the ports in the front valve chamber bushings. Where the auxiliary starting ports were formerly placed at the bottom of the bushings, they have

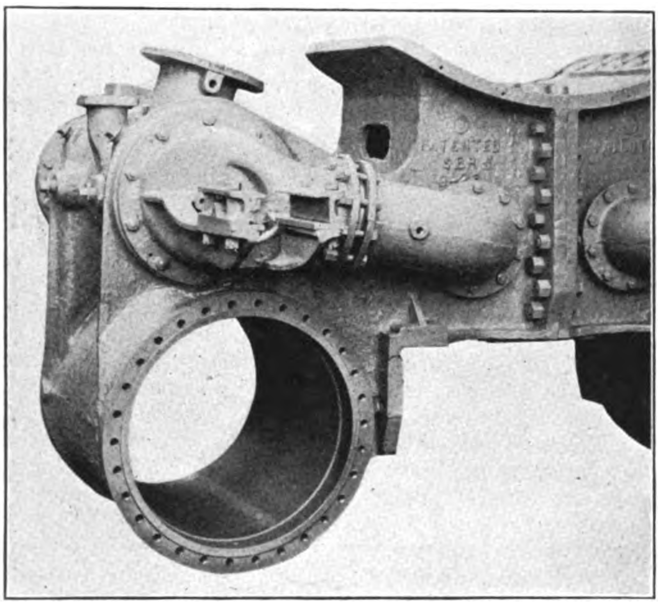
been moved around to the outside of the bushings in the Texas type locomotives, making them accessible for examination and cleaning by the removal of plugs from the outside walls of the valve chamber. Steam distribution is controlled by Baker valve motion producing a valve travel of 8¾ in., and by the Alco reverse gear.

The frame and running gear designs are the same in principal as those of the 2-8-4 type locomotive. The main frames terminate just back of the rear drivers and between them is bolted a heavy steel hinge casting in



Detail of the piston bull ring and Hunt-Spiller Duplex sectional packing rings

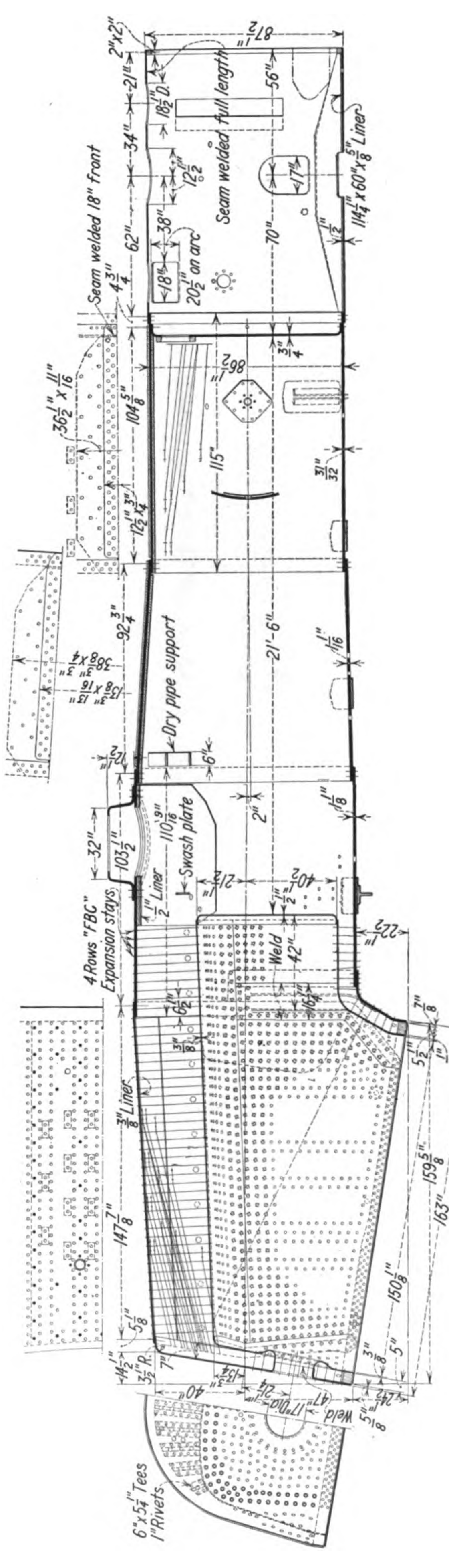
which the tongue of the articulated trailing truck is secured by an 8-in. hinge pin. Continuity of the alignment of the main frames and the trailer frame in every respect except lateral turning is secured by the bearing of the top rail of each main frame upon a sliding surface on the hinge extension of the trailer frame, and by supporting the rear end of the firebox directly on the rear end of the trailer frame through combined expansion and lateral motion roller bearings, one on each side of the locomotive.



The cast steel cylinders, showing one of the outside exhaust passages and a back valve chamber head

The front end of the firebox is supported from the rear end of the main frames by buckle plates.

The five pairs of drivers are continuously equalized on each side of the locomotive, starting from a fixed point back of each rear driver, and are cross-equalized with the engine truck. Each side of the trailing truck is equalized as a unit. This is the same system of equalization as that of the Lima A-1.

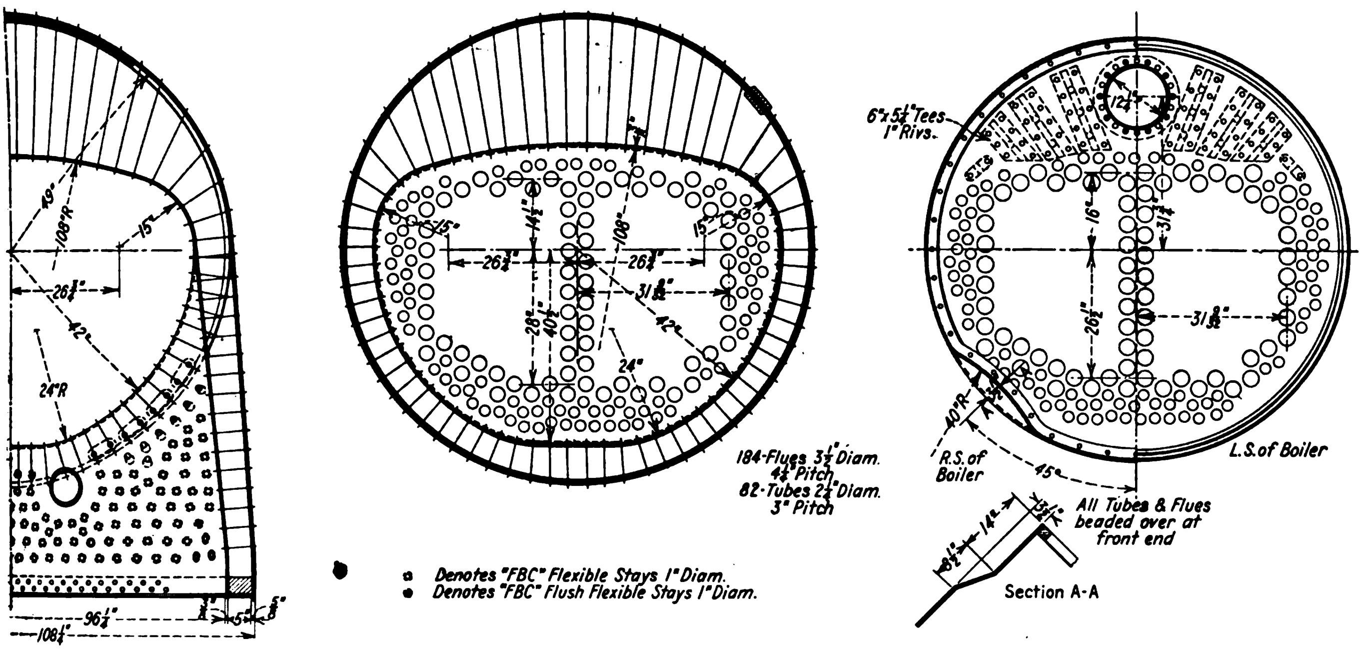


Longitudinal section through the boiler—On five engines the firebox seams are welded on the outside, on the other five, on the inside

The trailer frame of the Texas type locomotives is a one-piece steel casting, the front end of which forms the hinge and in the rear end of which is incorporated the pocket for the Unit drawbar between the engine and tender and on which is mounted the Radial buffer. This casting is shown in one of the photographs.

than enough to relieve the trailer of its load. The booster, which drives on the rear pair of trailing wheels, is supported from the truck frame by a yoke casting behind the wheels.

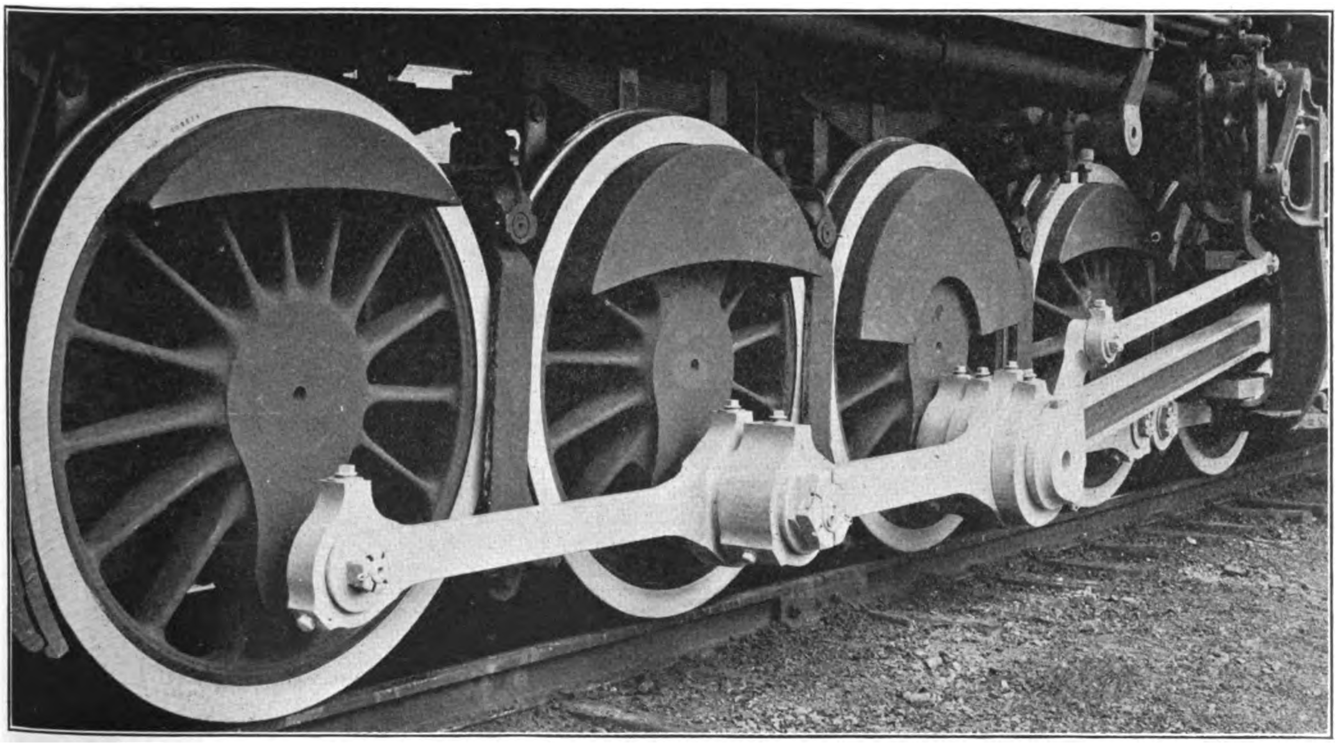
The five pairs of drivers are driven by articulated main rods of the type used on the A-1, driving on the third



Boiler sections, showing the tube sheet layout for the Type E superheater units

The cab is supported on cast steel arms which are bolted to the rear corners of the mud ring and in which are incorporated the top members of the expansion and lateral motion bearings. The wind sheet extending down from the rear end of the cab deck is divided into two parts so that by the removal of the lower sheet it is possible to run the trailer truck out from under the locomotive without lifting the rear end of the boiler more

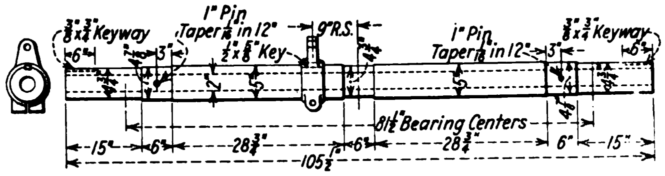
and fourth crank pins. Side rods distribute the load from the third pair forward to the second and first, and to the rear from the fourth to the fifth. An interesting feature of the rod arrangement is the setting out of the back side rod pin bearings 3 in. from the face of the wheels, the increased clearance thus provided being used to bring the center of gravity of the counterbalance of the fourth and fifth wheels out nearer to the plane of the



The articulated main rod connection between the third and fourth driving wheels

reciprocating parts. The forward driving axle is fitted with lateral motion driving boxes designed to provide a total lateral movement of 1½ in.

The material in the main and side rods is normal carbon-vanadium steel. The piston rods and crank pins are of chrome-vanadium, heat treated, the main crank pins being hollow-bored and the others solid. The piston

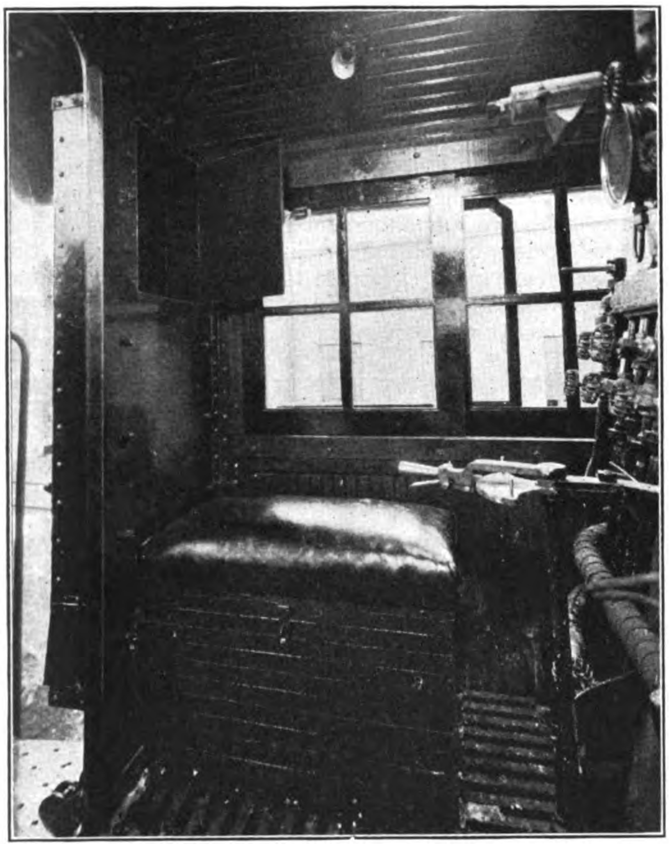


The reverse shaft is five inches in diameter, with a two-inch hollow bore

centers are Carnegie rolled steel fitted with Hunt-Spiller gun iron bull rings and packing rings.

Lubrication and auxiliary equipment

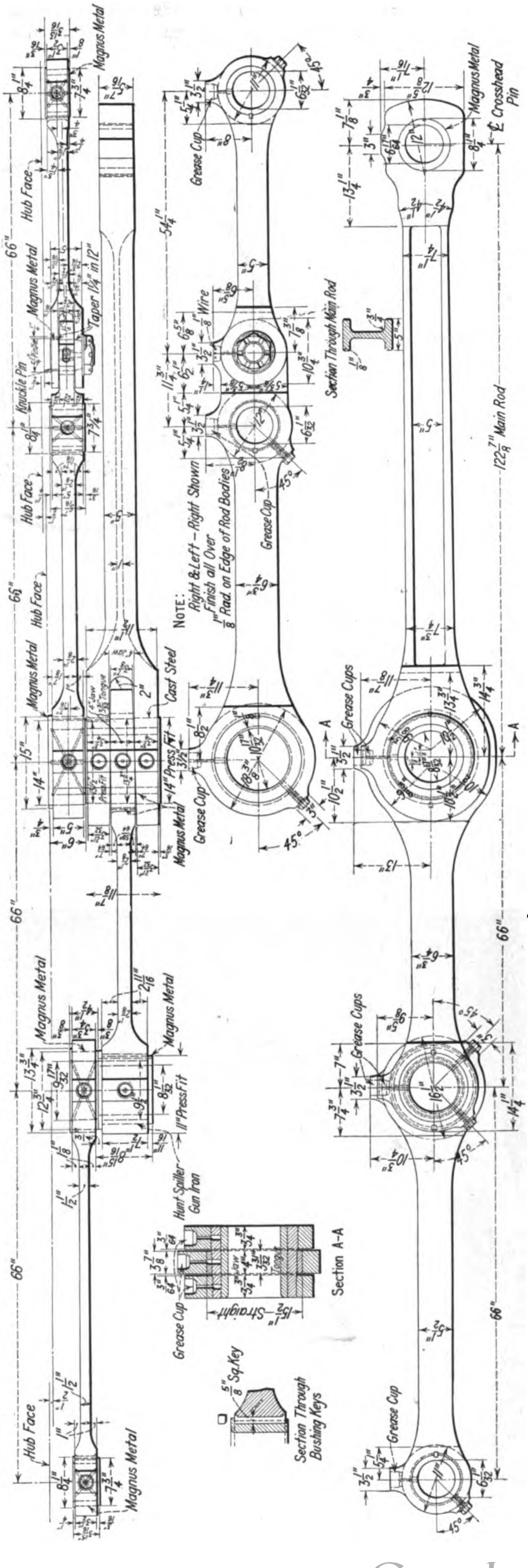
The cylinders receive lubrication from three sources. The principal source is a Nathan Type DV force feed lubricator, the four feeds of which deliver oil to the cylinders and the valve chambers. A Nathan five-feed hydrostatic lubricator is provided for the air pump, the



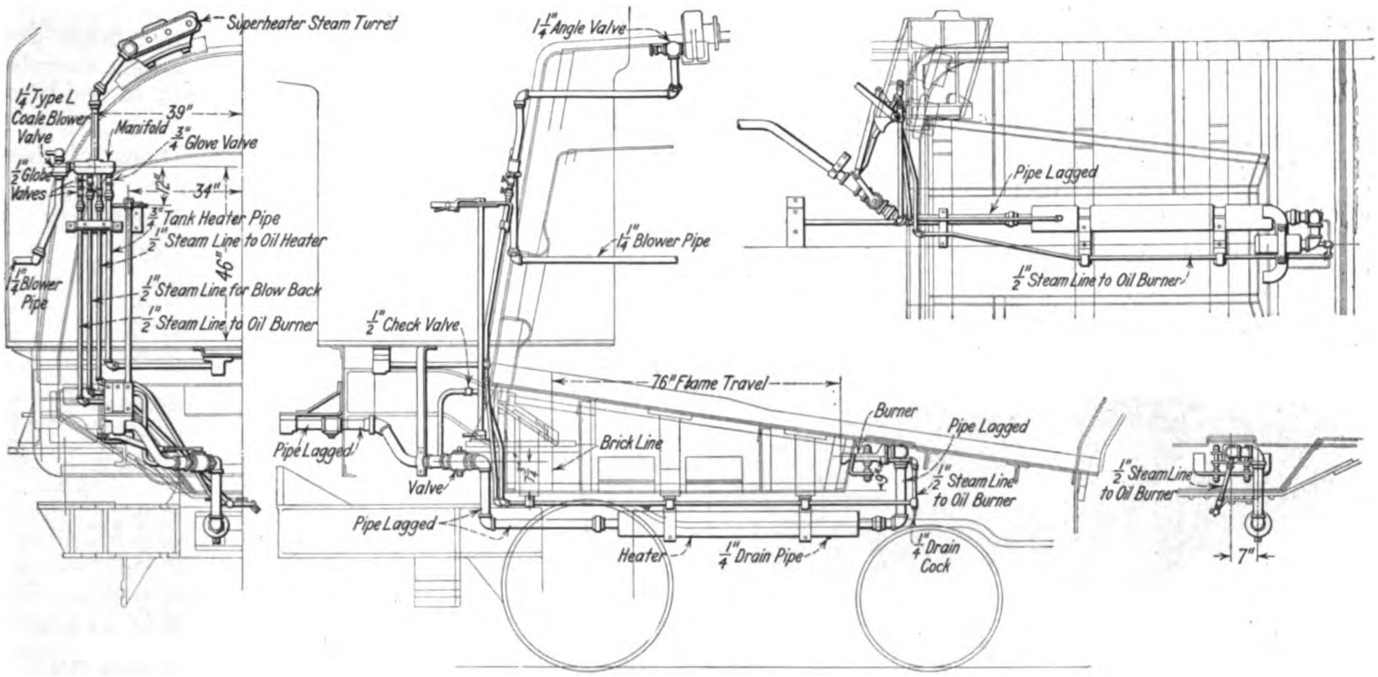
The fireman's side of the cab, showing the wardrobe locker

feedwater pump and the booster. The other two feeds are connected to the steam pipes as high above the cylinders as the fittings can be conveniently applied. In addition to these lubricators, a National Graphite Company pendulum type graphite lubricator is fitted in the neck of the superheater header where the saturated steam enters.

Superheated steam is carried back from the superheater header to a superheated steam turret on the left side of

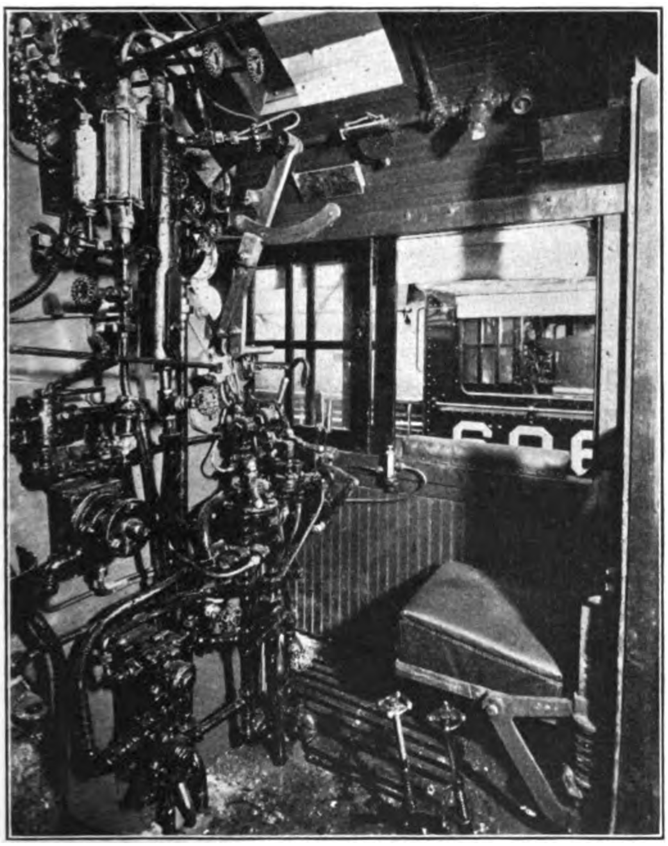


Details of the driving rods

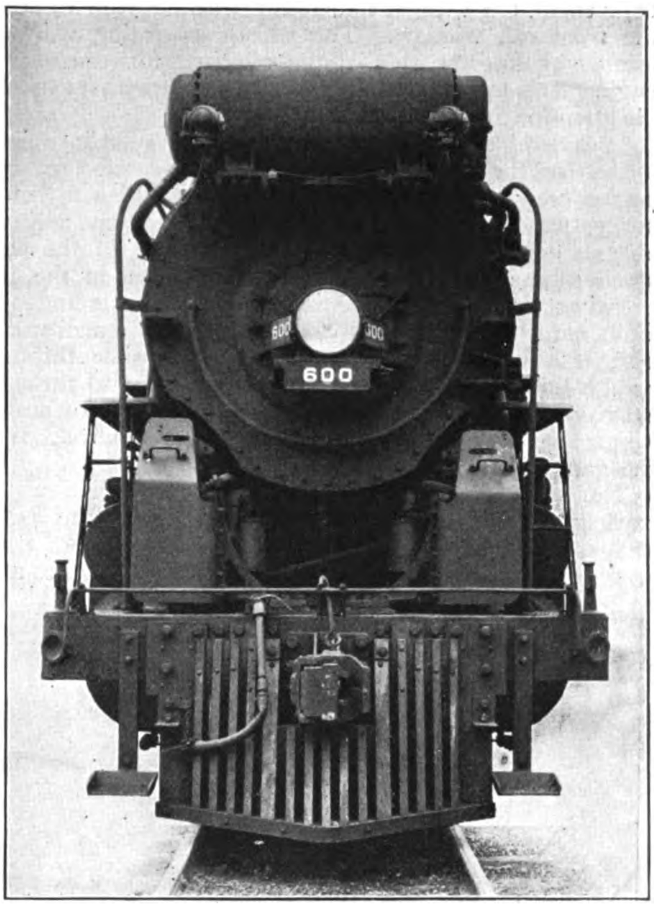


General arrangement of the oil burning equipment

the boiler just in front of the cab. This header furnishes steam to the air pumps, the feedwater pump, the headlight generator, the blower and the fuel oil heaters and atomizer. The whistle, which also uses superheated steam, is located well forward on the boiler alongside of the bell. The whistle fitting is welded directly on the superheated steam pipe which feeds the turret. The sound of the whistle is increased in volume and sharpness by the use of superheated steam, and this location—made possible by the use of the Parsons pneumatic operating rigging—protects the occupants of the cab from the unpleasant effect of this sound at close range. Placing the whistle well forward



The engineman's seat is spring suspended and folds back—The whistle valve is shown on the side of the cab at the front of the arm rest

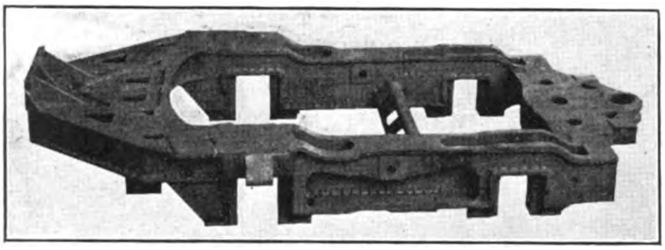


Front of the T. & P. locomotive, showing the location of the two cross compound air compressors

on the boiler and to one side, where it is not directly behind the stack, is also expected to effect some improvement in the forward projection of the sound.

One of the interesting details on this locomotive is the Unit pipe clamp and bracket for the main reservoir and running board. This provides a secure anchor for holding three lengths of air radiator pipe above the reservoir. The clamps are securely held by the same bolts which hold the running board in place.

One of the photographs shows the arrangement of the back boiler head fittings in the cab. It will be seen that great care has been exercised in arranging the control apparatus where it is conveniently accessible to the engine-



The trailer frame casting

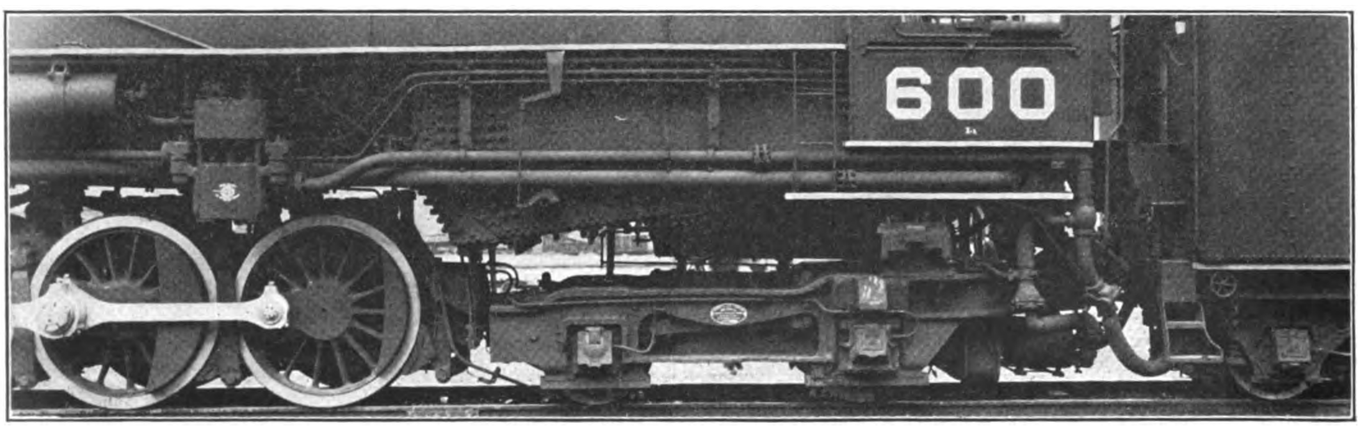
man and will not interfere with his movement to or from his seat. The water glass, the hydrostatic lubricator, the various pressure gages and the Boyer speed recorder dial have all been grouped and disposed where they can be seen at a glance, most of them directly in front of the engineman, but without interfering with his view through the front cab window. The whistle operating valve is located against the side of the cab just forward of the engineman's arm rest where he can press it without taking his attention from the track.

Considerable attention has also been given to arrangements for the personal convenience and comfort of the engine crew. The engineman's seat in addition to being spring upholstered, is also spring supported and adjustable in height. It may be folded back out of the way when room is needed by workmen employed in the cab or when the engineman wishes to work standing up. Built onto the wall of the cab back of the fireman's seat box, is a wardrobe locker. This is accessible through a high door back of the fireman's seat and also through a small door at the bottom in the gangway. An ample luggage rack is also provided under the cab roof over the gangway.

The locomotives are served by tenders with a water capacity of 14,000 gallons and a fuel oil capacity of 5,000 gallons. The tanks are of the Ralo-Acme type of construction, carried on Commonwealth cast steel frames and two Commonwealth six-wheel trucks. The tender has been designed to permit the application of a stoker with a minimum of alterations should it later become desirable to convert the locomotives from oil-burning to coal-burning service.

The principal dimensions and proportions of these locomotives are given in the following table:

Railroad	Texas & Pacific
Type of locomotive	2-10-4
Service	Freight
Cylinders, diameter and stroke, in.	29 by 32
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	8¾ in.
Steam lap	2 1/16 in.
Exhaust clearance	1/16 in.
Cut-off in full gear, per cent	60
Weights in working order:	
On drivers	300,000 lb.
On front truck	41,800 lb.
On trailing truck	106,200 lb.
Total engine	448,000 lb.
Tender	275,200 lb.
Wheel bases:	
Driving	22 ft.
Rigid	16 ft. 6 in.
Total engine	46 ft. 8 in.
Total engine and tender	86 ft. 8 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	36 in. and 43 in.
Journals, diameter and length:	
Driving, main	13 in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	7 in by 12 in.
Trailing truck	6½ in. by 12 in 9 in. by 14 in.
Boiler:	
Type	Taper course
Steam pressure	250 lb.
Fuel, kind	Oil
Diameter, first ring, outside	86½ in.
Firebox, length and width	150⅛ in. by 96¼ in.
Height mud ring to crown sheet, back	60¼ in.
Height mud ring to crown sheet, front	93 in.
Arch tubes, number and diameter	2 Syphons
Combustion chamber length	42 in.
Tubes, number and diameter	82—2¼ in.
Flues, number and diameter	184—3½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	No grate
Heating surfaces:	
Firebox and comb. chamber	3,755 sq. ft.
Syphons	98 sq. ft.
Tubes and flues	4,640 sq. ft.
Total evaporative	5,113 sq. ft.
Superheating	2,100 sq. ft.
Comb. evaporative and superheating	7,213 sq. ft.
Tender:	
Style	Rectangular
Water capacity	14,000 gal.
Fuel capacity	5,000 gal.
Rated tractive force	83,000 lb.
Rated tractive force, incl. booster	96,000 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	67.0
Weight on drivers ÷ tractive force	3.62
Total weight engine ÷ comb. heat. surface	62.1
Boiler proportions:	
Tractive force ÷ comb. heat. surface	11.5
Tractive force × dia. drivers ÷ comb. heat. surface	725.
Firebox heat. surface ÷ grate area	4.73
Firebox heat. surface, per cent of evap. heat surface	9.26
Superheat. surface, per cent of evap. heat. surface	41.1



The firebox and articulated trailing truck

Some suggestions for future locomotive development

Electric control of steam distribution—Multi-cylinder construction provides smooth torque

By William A. Newman

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Part I

UP to within the past few years, the development of the steam locomotive has been along the lines of a natural increase in capacity, weight and refinement of details. At the present time, we find that through normal growth, the modern locomotive in America has just about reached its ultimate stage of development as regards physical restrictions of height, width and length. The weight factor is also becoming one of extreme seriousness, with the continued increase in loads on the axle.

The present trend of development still appears to be along the lines of further increases in capacity, together with improvements in operating and fuel efficiency. Efforts in this direction are in the main still centered on refinement and changes in details of construction, together with the addition of auxiliary equipment and appliances. In Europe and to some extent in America, there is also a considerable tendency towards experiments with new forms of power application such as the steam turbine and both the indirect and direct drive Diesel locomotive, a few of which are in actual operation.

In considering the possibilities of the locomotive of the future, possibly the electric locomotive should merit first consideration. It has many manifest and marked advantages as an operating unit, and without doubt, will be more widely used in the future than in the past. The very large initial plant and equipment investment required for electrification makes it doubtful, however, whether the use of the electric locomotive can ever be universal, as long as present first costs are maintained and further reductions in cost of transportation are still possible with more improved forms of heat engines. It would, therefore, appear logical that the future development of motive power will naturally include more refined an efficient forms of the heat engine, in view of the great possibilities for large gains in economy.

The steam turbine and Diesel locomotives are still in the development stage. The steam turbine is fundamentally a high speed unit requiring stepping down to normal axle speeds by some form of transmission, and should operate condensing for greatest economy. With existing traffic conditions in America, there can be little, if any, falling away from the present standard of high sustained tractive forces at fairly high speeds. This, in turn, calls for large horsepower development, which makes it problematical whether boiler, turbine, transmission, condenser and fuel and water storage space can in a practical way, be fitted together within existing clearance restrictions. The same statement applies to the various forms of Diesel locomotive; that is, there are serious constructional difficulties to be surmounted with the large horsepower development necessary for the high tractive efforts now demanded. One can go further and say that not only is it necessary for successful turbine and Diesel locomotives to duplicate existing accomplishments, but they must also be possible of development to meet future demands for greater capacity motive power.

The weak points of design in the modern locomotive

It would seem that the most promising line of development still remains with the reciprocating steam locomotive in whatever form it may be used. It would also appear that there is more possibility for gains in economy with the use of steam than with any other method of application of energy, as the present very low thermal efficiency of the steam engine leaves a margin for future savings greater than in practically any other field. It is quite within reason that some form of steam generation may skip the latent heat stage and give us steam with a very greatly reduced consumption of heat units, or that a cycle of operation be evolved that would largely eliminate the existing serious losses of the latent heat stage of the present operating cycle.

Having narrowed down the field for maximum possibilities of future development to the reciprocating steam locomotive, an analysis of the development of the present type of locomotive is next in order. Going over the manner of wheel arrangement, boiler construction and attachments, without question the modern locomotive is the same in principle as the earliest forms of successful locomotives put into regular operation. It is true that the development and refinement has resulted in a machine of excellent efficiency and suitability for American conditions, but it is also true that some marked departure from the present forms of construction must be made to continue further progress in capacity and efficiency if such is required. It is also a fact that in evolution by mere growth, we have introduced certain factors not conducive to minimum maintenance. In particular, the present size of cylinders, pistons, crossheads and rods are exceedingly difficult to handle, produce high stresses, and furthermore through the very large piston thrust, bring a tremendously concentrated load on any one part through faulty alinement or improper maintenance costs. The revival of old forms of locomotives such as the compound and the three-cylinder locomotive, cannot altogether solve the future problems, as the additional mechanical complications with little, if any, reductions in piston thrusts only increase maintenance difficulties. With all these factors disclosed, the thought presents itself, would it not be possible, for example, to go back to Stevenson's starting point, and with the wealth of engineering knowledge and experience today available, conceive a new type or form of locomotive construction that would have as great a margin of development before it, as was true of Stevenson's locomotive, "Rocket"?

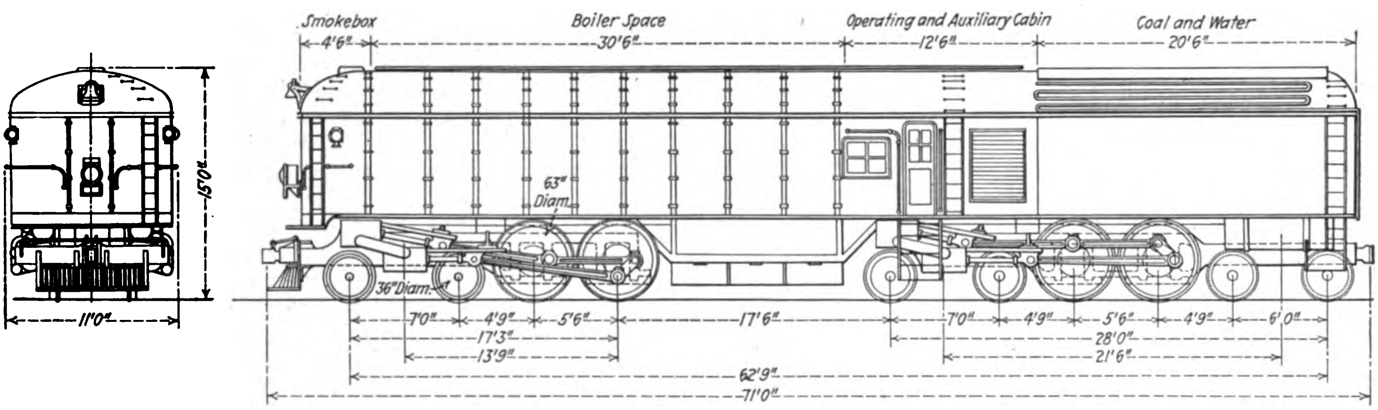
Fundamentals defined for proposed locomotive

To determine what would be possible from this standpoint, a proposed type of locomotive has been worked out

and at the outset, it must be stated that the following constitutes only a grouping of ideas, which although fairly well thought out as regards the detailed form of construction, have not been fully investigated, so that it is the ideas themselves that must be adopted or discarded on their own merits. It should also be clearly stated that the whole object in putting forward this suggested type of locomotive is to demonstrate that the possibilities of increased capacity and greater economy of the steam locomotive have by no means been exhausted.

As a starting point, two features of the electric locomotive have been adopted as permitting a wide range in flexibility of control and operation. These are: first, the electric control and operation of all auxiliaries and auxiliary devices; second, as close an approach to the constant torque of the electric locomotive as is feasible.

To accomplish the first, it is proposed to use a turbine-driven generator for the developing of sufficient current to take care of the operation of auxiliaries, the manipulation of main distributing valves and throttle and reversing controls. To obtain the second objective, it is proposed to use multi-cylinder construction. To obtain the maximum thermal efficiency, high steam pressure and high superheat are necessary and also tend to improve construction through the use of smaller parts and the greater possibilities for work production of the more highly superheated steam.



Schematic view of the proposed steam locomotive

The design of the boiler and frame

With these fundamentals defined, the selection of a form of assembly is the next step. Here boiler construction enters, and it becomes at once apparent that a revision in type of boiler is essential for the use of higher pressures and for obtaining greater steam producing capacity. The particular form of boiler to be used is more or less immaterial, in fact, it might be possible to develop a boiler along several different lines which might be perfectly capable of the development necessary to take care of the further growth of locomotive capacity. It is, however, felt that any boiler design that is now proposed will only be tentative at the best, as it is practically a certainty that radical departures in methods of steam generation will in the future open new fields of locomotive development. In order to present the form of the locomotive now proposed as a whole, one type of boiler has been worked up in which only more or less accepted forms of construction have been followed. While higher pressures will undoubtedly be used in the future, it is thought advisable to adhere to a moderate advance in pressure at the start. For this reason, 300 lb. boiler pressure is suggested.

The boiler itself is divided into two stages, the high pressure stage carrying 300 lb. In this stage pressure is confined entirely to small diameter evaporating tubes and a central storage drum, together with the necessary headers.

The low pressure stage acts as a combined secondary feedwater heat and water purifier. The low pressure side of the boiler also forms a container for the nests of evaporating and superheater tubes. Briefly, the water is first fed into the low pressure stage at 170 lb. pressure, in which the water is heated to the corresponding temperature for this pressure, and then passed into the high pressure stage where the evaporation occurs.

As the height and weight restrictions are immovable, it is imperative that the weight be used to better advantage, which is possible in multi-cylinder construction, as the adhesion necessary is reduced. The utilization of the weight of fuel and water also forms a possible means for the better use of weight. It is suggested that the locomotive construction as a whole be in the form of a main unit, consisting of the boiler, operating cabin, fuel and water storage space, with the necessary auxiliaries, etc., all mounted on one frame of which the boiler construction forms a part. This frame would be mounted on forward and rear pivoting trucks. Each truck would consist of a group of driving wheels and smaller guiding wheels with four steam cylinders to each truck or driving unit, the steam supply and exhaust for which are carried through the pivoting center, so as to reduce the angular movement to be provided for in the flexible connections. To demonstrate the possibilities of construction of this form, a moderate size locomotive has been selected which is shown to scale in one of the illustrations. This particular locomotive is suggested as a general service unit suitable for either freight or passenger requirements, as the characteristics of the proposed engine would make the size of the wheels selected suitable for moderate high speed work, as well as for heavy sustained tractive force. The various details of construction that are suggested may now best be described by an explanation of the different constructional features of the proposed locomotive which, on account of the electrical control, has been termed a thermo-electric locomotive.

Forward and rear driving units

The forward driving unit consists of two pairs of drivers with one four-wheel guiding truck. The rear driving unit is a duplicate of the leading, with the exception that a four-wheel trailing truck is used as well as the four-wheel guiding truck. The exhaust from the forward cylinders is emitted directly through the stack, whereas the exhaust from the cylinders of the rear unit is led into the water storage space, and partially utilized for feedwater heating. Outside of the foregoing differences, both trucks are alike in all details, and the parts are largely interchangeable.

The frames are cast with both sides integral with cross ties and bracing, similar to what has been done on recent electric locomotives, to give maximum strength with minimum weight. In each driving unit the two pairs of drivers are driven by four cylinders, all cylinders being mounted on the outside of the frames. The upper pair of cylinders drives the first driving wheels and the lower pair the second driving wheels. The upper cylinder drives direct on a main crank pin, such as is used in customary locomotive practice. The lower cylinder drives on a crank pin carried on a return crank, the inner portion of the return crank serving as a bearing for the side rod connecting the two pairs of drivers together. This return crank with both inner and outer bearings is constructed from a solid forging pressed and keyed directly in the driving wheel center. The cylinders, to develop a tractive effort of 71,400 lb., are 13 in. in diameter with a 26-in. stroke. These take up a very small amount of room compared with modern practice, and together with the use of frames cast integral, will permit the use of four wheel trucks having outside bearings which allow the use of standard A. R. A. axles and journal boxes, etc., which should materially assist in engine truck maintenance.

The small cylinders, even with 300 lb. pressure, give a comparatively small piston thrust judged by modern standards, which in turn gives much smaller piston heads, piston rods, crossheads, main rods, and crank pins, all of which will greatly reduce concentrated loads and stresses caused by rotating and reciprocating weights.

The introduction of four pairs of cylinders on the complete locomotive would, at first glance, appear to be prohibitive on account of valve gear complications. Here, however, it is proposed that electrical energy be used to control the movement of the valves, and thereby provide a greatly simplified arrangement as compared with the present types of valve motion. The cylinders themselves, on account of the small volume, require comparatively small valve openings, which in turn will permit the use of considerably over-size valves to permit a freer flow of steam than is possible with present conditions. The valves themselves may be either of the poppet or piston type, and in the proposed locomotive, the piston type of 6-in. diameter are proposed. The valve spindle projects through the customary type of packing and the valve itself is actuated by an electro magnet operating against helical spring pressure. Separate admission and exhaust valves are used so that the arrangement becomes very similar to what is used in internal combustion engines wherein spring pressure is used to seat a poppet valve, after it has been mechanically opened. The energizing of the electro magnets is accomplished by moving contact points carried on a rotor keyed on either one of the main axles between the frames. The moving contact points make and break the contact with the segments of a commutator ring fixed concentrically with the rotor and free to move vertically up and down, but not capable of rotating relatively to the rotor. The segments on 180 deg. of the commutator represent a cut-off from zero to 100 per cent and control the flow of steam in one end of one cylinder, and in the opposite end of the corresponding cylinder on the opposite side of the engine, these cranks being set 180 deg. apart. The remaining 180 deg. of the commutator controls the steam flow in the opposing ends of the same pair of cylinders.

The cut-off is adjusted by having a control lever in the operating cab, which moves on a segment, the forward half of which represents the forward cut-off, and the rear half, the reverse motion. Each half is divided into contact points coinciding with the divisions on the 180 deg. of the fixed commutator rings surrounding the contact rotors on the axles. Connections are so arranged that contact is made at the fixed lead point and broken at the segment at which the control lever is placed in the cab. Exhaust valve release and the closures are controlled by fixed contact points independent of cut-off changes.

By operating the control lever on the reverse section of the control quadrant, the magnet connections are reversed, thereby changing the valve movement just as in an ordinary mechanical valve motion.

To prevent arcing as the electro magnets come in or out of play a high resistance shunt is employed so that current is always flowing in the electro magnet circuit, thereby preventing damage to contact points.

This explains the general principle proposed, the control of all cylinders being worked out similarly, one compound rotor and stationary commutator serving for each power truck.

The advantages of such a system are many. In the first place, almost instantaneous valve action is obtained, the movement of the valves being many times faster than the fraction of time in which a very small angular movement of the driving wheels occurs. This means that under all conditions the valve is fully opened from zero to 100 per cent cut-off, and that a free and uninterrupted flow of steam is thereby insured. Then, too, the cut-off action will be much crisper. With the cut-off of the current, the strong spring action will give a slower, though still practically instantaneous valve closure. If necessary, magnetic force can also be used to produce the closure of the valves.

The lubrication of the valves and cylinders is effected by a force feed lubricator mounted on the engine frame, gear driven by a small size enclosed weatherproof electric motor, so connected electrically that it cuts in when the locomotive starts and cuts out when the locomotive stops. If desired, it can also be arranged so that the amount of oil feed can be registered electrically in the cab so that the engineman will have complete knowledge of the amount of lubricant being fed to cylinders on both the front and rear driving units. It is proposed to bring down through the center plate connection the steam supply to the cylinders, together with the exhaust, which will be of comparatively large diameter. The exhaust and live steam will be carried in separate passages so arranged that there will be only one flexible joint for live and one flexible joint for exhaust steam. Outside of these joints, no mechanical connections between the driving units and the main portions of the locomotive are required. There will be only air connections of the usual type and electric cable connections so arranged that the detachment of the driving unit from the main frame can be quickly and readily carried out to facilitate shop repairs.

The tractive force exerted by the leading truck will be taken up on special roller radial thrust bearings surrounding the forward center plate, which means that the locomotive body would be called on to transmit the tractive force of the leading driving unit backwards to the rear driving unit, which would carry the draft gear and coupling arrangements.

(To be concluded in the February issue)

THE AVERAGE COST per ton of coal used as fuel for road locomotives in freight and passenger train service, charged to operating expenses, for Class 1 railways in October, 1925, was $2.06 as compared with $2.85 in October, 1924, according to the Interstate Commerce Commission's monthly bulletin. Fuel oil cost 3.12 cents in October, 1924. The total cost of coal and fuel oil for the month was $30,293,706, as compared with $29,888,414 in 1924. For the ten months ended with October the average cost of coal was $2.73, as compared with $3.08 in 1924. Oil cost 3.18 cents as compared with 2.78. The total cost of coal and fuel oil was $271,728,983, as compared with $295,671,213 in 1924. For coal alone the total cost was $217,334,932, as compared with $247,866,834.

Annual report of the Bureau of Locomotive Inspection

Forty-six per cent of the locomotives inspected were found defective — Improvement over preceding years

THE fourteenth annual report of the chief inspector of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the year ending June 30, 1925, again emphasized the fact that the autogenous welding of parts of the locomotive or tender, where through the failure of such parts there is a possibility of accident and injury to persons, had not yet reached the stage in its development where it could be used with safety. In the thirteenth annual report, an abstract of which was published in the January issue of the *Railway Mechanical Engineer,* attention was directed to accidents investigated where welds made by the autogenous process were involved. It was stated in that report that approximately 78 per cent of autogenously welded seams involved in firebox failures were torn, while only 15.4 per cent of riveted seams involved had failed. This report pointed out that from July 1, 1915 to June 30, 1924, autogenously welded seams were involved in 26.9 per cent of the crown sheet failures, while 50.7 per cent of the persons killed in such accidents were killed in cases where the autogenously welded seams were involved. During the 12 months' period covered by the fourteenth annual report, numerous other accidents of the same or similar nature have occurred, views of some of which are shown in the illustrations.

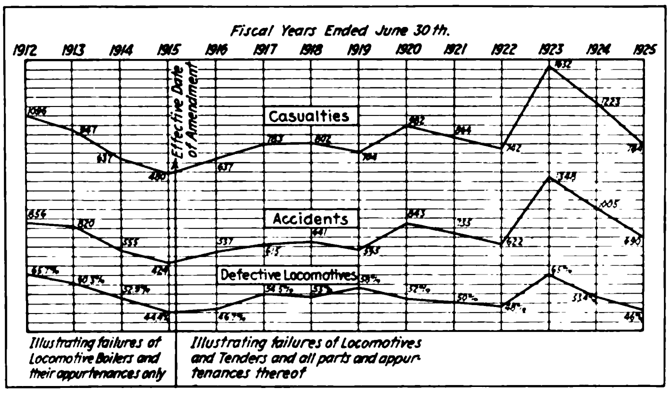
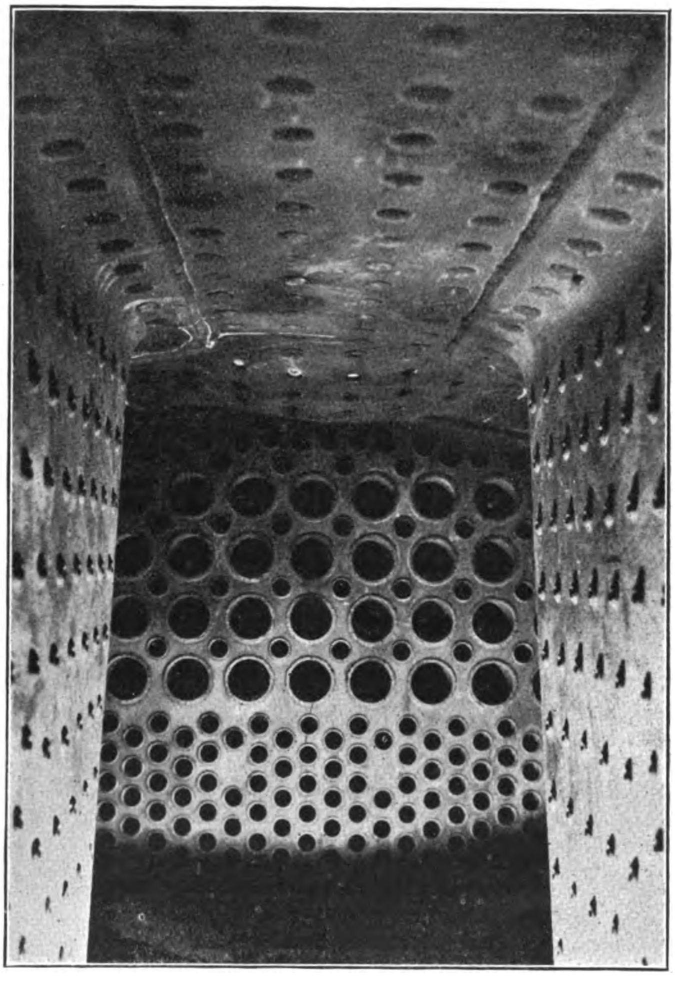


Chart showing the relation of defective locomotives to accidents and casualties resulting from locomotive failures

The present report contains a summary of all accidents and casualties occurring during the year ending June 30, 1925. A total of 690 accidents occurred in the 12 months' period covered by the report, a decrease of 31.3 per cent from the number shown in the preceding period. With the exception of the 12 months' period for 1921 and 1922, this is the lowest number of accidents reported since 1920. There were 20 persons killed during the period covered by this report as compared with 33 killed in 1921-22, the lowest number of fatalities previously reported since 1920.

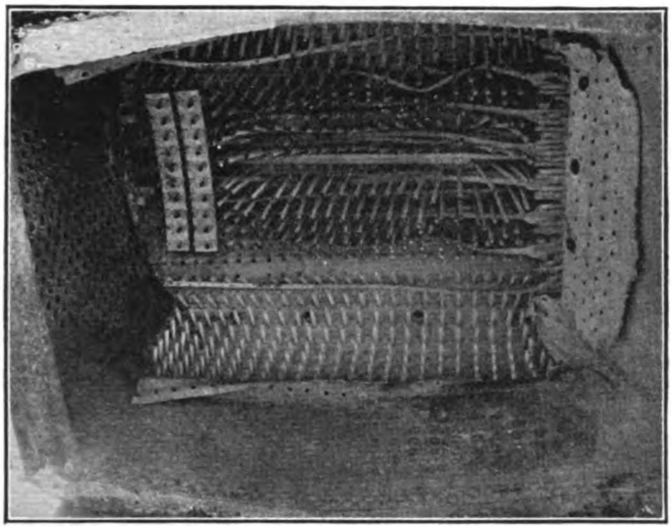
The greatest number of accidents was due to defective grate shakers of which there were 57. Fifty-three accidents were due to defective squirt hose, 49 to defective reversing gears, 36 to defective flues and 31 to defective brakes and brake rigging. Three fatalities were caused by defective brakes and brake rigging, which stands second in the list of appurtenances causing fatal accidents. The greatest number of deaths were caused by boiler explosions. Twelve persons were killed by boiler explosions, 10 crown sheet failures on account of low water and two were due to defective staybolts in the firebox. An abstract of the report follows:



Crown sheet damaged on account of low water—The two thermic syphons discharged sufficient water to keep part of the crown sheet from becoming overheated

A summary of all accidents and casualties to persons occurring during the year ending June 30, 1925, as compared with the previous year, covering the entire locomotive and tender and all of their parts and appurtenances, shows a decrease of 31.3 per cent in the number of accidents, a decrease of 69.7 per cent in the number

of persons killed and a decrease of 33.9 per cent in the number injured during the year. There was also a substantial decrease in the percentage of locomotives, inspected by our inspectors, found defective as compared with the previous year. During the year 46 per cent of



Approximately 23 ft. of autogenously welded seams in this firebox failed at the time the boiler exploded

the locomotives inspected were found with defects or errors in inspection that should have been corrected before being put in use, while during the previous year, 53.4 per cent of those inspected were found defective.

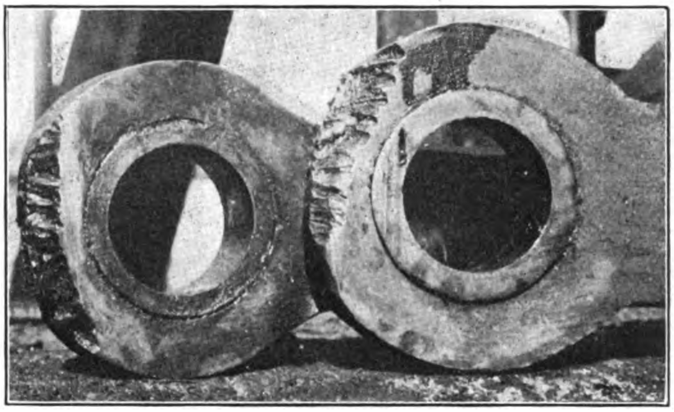
Derailments due to defects in or failure of some part of the locomotive or tender

	1925	1924	1923	1922	1921
Number of derailments*	22	30	38	22	8
Number of persons killed	..	3	4	5	..
Number of persons injured	52	112	157	61	30

*Only derailments reported by carriers as being caused by defect in or failure of parts of the locomotive or tender were investigated or counted.

While there was a substantial decrease in the total number of accidents occurring during the year, our investigation shows that a still greater decrease should have resulted had the requirements of the law and rules been complied with, especially so with respect to parts and appliances which are sometimes considered unimportant. Special attention is directed to the reduction in the number of boiler explosions caused by low water during the year. Boiler explosions are the most prolific source of serious and fatal accidents with which we have to deal, therefore, during the course of our regular work, special attention has been given to conditions which contribute to such accidents. A great deal of consideration has been given to the action of the water in the boiler and its effect upon the water indicating appliances and the result of our study in this matter has been brought to the attention of those in charge of locomotive maintenance and operation, as well as those actually operating locomotives. The reduction in the number of crown-sheet failures as shown is no doubt largely brought about as the result of our study with respect to the circulation of the water in the boiler and its effect upon water glasses and especially upon gage cocks when screwed directly into the boiler, and to our action in insisting that water indicating appliances and other parts, which may contribute to such accidents, be maintained to a high degree of perfection so that they will perform their functions in a proper manner.

One of the tables shows the various parts and appurtenances of the locomotive and tender which through failure have caused serious and fatal accidents, which if



Two side rods burned off at the ends with a torch to provide clearance—The Bureau considers such methods unsafe

taken advantage of and proper inspections and repairs are made in accordance with the spirit and intent of the law and rules, a large portion of such accidents can be avoided. The graphic chart shows the relation between the percentage of defective locomotives and the number of accidents and casualties to persons resulting from the failure thereof, and illustrates the effect of operating locomotives in a defective condition from the viewpoint of safety.

Persons killed and injured, classified according to occupations

	1925		1924		1923		1922		1921	
Members of train crews:	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Enginemen	8	230	19	330	19	484	11	213	15	237
Firemen	6	300	22	434	16	597	10	277	25	360
Brakemen	2	84	9	102	12	137	7	66	13	64
Conductors	..	25	2	39	1	35	...	25	2	20
Switchmen	..	23	1	29	2	32	1	13	3	15
Roundhouse and shop employees:										
Boilermakers	..	6	1	24	3	19	1	10	1	7
Machinists	..	13	1	9	2	14	...	9	1	3
Foremen	..	...	1	6	1	6	...	1	1	3
Inspectors	..	2	1	3	...	2	...	2	...	5
Watchmen	1	3	...	5	1	6	...	3	...	4
Boiler washers	..	5	2	5	1	9	...	1	...	7
Hostlers	..	16	...	14	...	31	...	10	...	8
Other roundhouse and shop employees	..	10	6	34	4	29	1	15	1	25
Non-employees	2	34	...	16	4	36	2	23	2	16
Other employees	1	13	1	107	6	123	...	41	...	21
Total	20	764	66	1,157	72	1,560	33	709	64	800

Autogenous welding

In the thirteenth annual report, attention was directed to accidents investigated where welds made by the autogenous process were involved. During the year, numerous other accidents of the same or similar nature have

occurred, our investigation of which serves to establish the soundness of our recommendation, previously announced, that this process has not yet reached a state of development where it can be safely used on parts of the locomotive or tender where through failure of such parts accident and injury to persons might result.

Extension of time for removal of flues

During the year ending June 30, 1925, 146 applications were filed for extension of time for the removal of flues, as provided in Rule 10. Our investigation disclosed that in 14 of these cases, the conditions were such that no extension could properly be granted. Fourteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period of time was allowed. Nineteen extensions were granted after defects disclosed by our investigation had been repaired. Eighteen applications were canceled for various reasons. A total of 100 applications were granted for the full period requested.

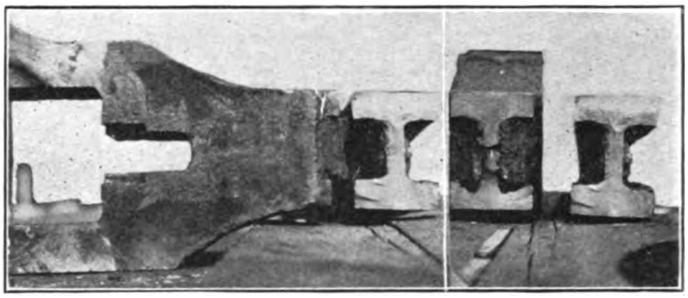
Number of locomotives reported, inspected, found defective, and ordered from service

Parts defective, inoperative or missing, or in violation of rules	1925	1924	1923	1922
Air compressors	1,574	1,221	1,390	971
Arch tubes	198	272	468	151
Ash pans or mechanism	216	257	306	161
Axles	14	19	.21	15
Blow-off cocks	825	965	1,578	975
Boiler checks	991	1,329	1,913	949
Boiler shell	1,597	2,103	2,370	1,598
Brake equipment	6,497	6,920	8,213	4,577
Cabs or cab windows	2,541	1,627	1,423	1,276
Cab aprons or decks	1,165	1,293	1,476	1,098
Cab cards	665	758	1,449	567
Coupling or uncoupling devices	447	398	634	423
Crossheads, guides, pistons or piston rods	2,922	3,577	5,527	1,920
Crown bolts	283	418	630	331
Cylinders, saddles, or steam chests	4,352	5,712	4,875	3,234
Cylinder cocks or rigging	1,801	2,376	1,745	1,201
Dome or dome caps	371	494	626	331
Draft gear	2,283	1,981	2,613	1,526
Draw gear	3,273	4,160	4,513	3,042
Driving boxes, shoes, wedges, pedestals, or braces	3,241	3,722	4,269	2,776
Firebox sheets	1,152	1,471	2,327	1,191
Flues	524	698	1,268	521
Frames, tail pieces, or braces, locomotive	2,036	2,580	2,683	2,078
Frames, tender	391	414	540	352
Gauges or gauge fittings, air	694	626	1,062	399
Gauges or gauge fittings, steam	1,809	2,026	3,075	1,595
Gauge cocks	3,081	3,835	5,895	3,275
Grate shakers	832	1,006	569	425
Handholds	2,831	2,241	1,990	1,533
Injectors, inoperative	70	94	251	94
Injectors and connections	8,064	9,985	12,406	7,741
Inspections or tests not made as required	10,436	9,740	7,419	4,114
Lateral motion	659	939	1,625	976
Lights, cab or classification	86	72	90	80
Lights, headlight	928	904	1,164	705
Lubricator or shields	704	565	566	456
Mud rings	1,384	1,901	2,711	1,598
Packing nuts	2,761	3,304	4,755	3,151
Packing, piston rod and valve stem	2,411	3,187	3,359	1,756
Pilot or pilot beams	832	967	1,294	679
Plugs or studs	849	1,026	857	443
Reversing gear	1,274	1,217	1,272	789
Rods, main or side, crank pins or collars	4,813	6,507	10,080	3,915
Safety valves	234	188	192	162
Sanders	2,004	1,806	1,857	1,165
Springs or spring rigging	5,532	6,335	7,911	5,497
Squirt hose	1,008	1,221	1,098	935
Staybolts	741	916	1,313	722
Staybolts, broken	3,745	5,320	10,089	4,261
Steam pipes	1,590	2,305	2,467	1,461
Steam valves	869	981	1,168	791
Steps	2,867	2,829	3,289	2,038
Tanks or tank valves	3,352	3,393	3,788	2,817
Telltale holes	451	620	715	630
Throttle or throttle rigging	2,403	2,868	2,633	1,880
Trucks, engine or trailing	2,966	3,425	3,899	2,467
Trucks, tender	5,372	5,977	3,714	2,551
Valve motion	1,250	1,269	1,761	710
Washout plugs	3,588	3,204	3,641	2,449
Water-bars or combustion flues	19	18	24	57
Water-glass, fittings, or shields	3,713	4,201	5,641	3,640
Wheels	2,148	2,996	4,371	2,410
Miscellaneous—Signal appliances, badge plates, brakes (hand)	1,510	1,342	972	403
Total number of defects	129,239	146,121	173,840	101,734
Locomotives reported	70,361	70,683	70,242	70,070
Locomotives inspected	72,279	67,507	63,657	64,354
Locomotives defective	32,989	36,098	41,150	30,978
Percentage inspected found defective	46	53	65	48
Locomotives ordered out of service	3,637	5,764	7,075	3,089

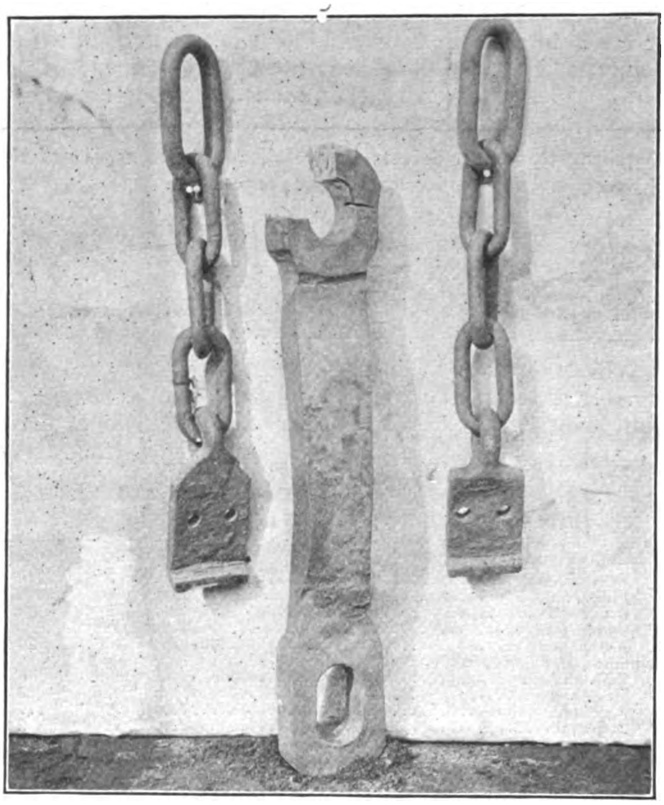
No formal appeal was taken from the decisions of any inspector during the year.

Amendment to the law

The act of June 7, 1924, further amending the locomotive inspection law extended our jurisdiction to all locomotives and tenders, their parts and appurtenances, used or permitted to be used on the line of a common carrier subject to the Interstate Commerce Act, which includes locomotives propelled by electricity, gasoline, compressed air, or other means, whereas prior to this amendment, the law applied only to steam locomotives used by common carriers subject to the law. The amendment of June 7, 1924, also provided for the appointment of 15 additional inspectors. This number of inspectors was appointed and actively engaged in the performance of their duties for an average period of three months during the year ending June 30, 1925.



Two views of a main rod that failed in service—This rod had been built up by autogenous welding



Drawbar and safety chains which failed because of crystallization of the drawbar—The 7/8-in. bolts securing the safety chains sheared when the drawbar broke

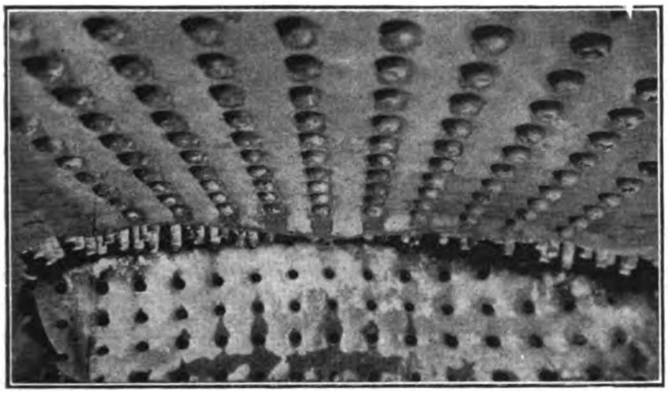
The preparation of rules and instructions fixing mini-

mum requirements for all locomotives other than those propelled by steam power is being pursued and arrangements are being made to put into effect the additional requirements as soon as possible.

The carriers having failed to file their rules and instructions for the inspection and testing of locomotives other than steam within three months after the amendment of June 7, 1924, became effective, it became my duty to prepare rules and instructions not inconsistent with the purpose of the law, which I did, in connection with which it has been deemed advisable to have a conference with the parties at interest for the purpose of coming to a common understanding so that the rules and instructions may be approved by the Interstate Commerce Commission as required by law.

Bureau asks for legal assistance in enforcing the law

A large percentage of the accidents which we have investigated were caused by defects which could have been prevented had proper inspections and proper repairs been made at the proper time. Many locomotives are allowed



Result of a crown sheet failure due to low water—Autogenously welded seam between the combustion chamber and crown sheet failed for a distance of 51 in.

to remain in use in apparent disregard for the requirements of the law, sometimes until accidents occur and many times until our inspectors find them and order them out of service. We are daily writing many letters to various carriers calling attention to their failure to comply with the requirements of the law, such as failure to make the required periodical inspections and tests and the failure to make proper repairs to defects which constitute violations of the law. With the large number of locomotives in service, scattered over such a wide area, it is apparent that Congress never intended that the law should be entirely enforced by our inspectors ordering locomotives out of service because of being in violation of the law. It is a physical impossibility for the 65 inspectors now provided to keep in sufficiently close touch with the number of locomotives coming under the jurisdiction of the law to know at all times that they are in condition to meet the requirements thereof.

Therefore, in the light of our experience, I most respectfully recommend that competent legal assistance be provided this bureau so that we may at all times have the benefit of such services in seeing that the law and the rules and regulations issued in pursuance thereof are complied with.

THE LARGEST RAILWAY LOCOMOTIVE in Australia will be built by the Victorian Railways at the Newport, Victoria, workshops. The engine is to be of the three-cylinder Pacific type, and is expected to be ready by the end of next year. It is said that the locomotive will have a tractive power of 40,000 lb.

Applied Man-Power*

By W. B. Zimmerman
Car Foreman, Lincoln, Neb.

THE record of railroad progress is that of applied science and applied man-power. Compared with other leading industries there are some who think that the railroad is a little behind the times in each; of the two, the progress of applied science has been much the more marked. We should keep pace in the progress of applied man-power. In this step the foreman is the most important man in the railroad organization. He is the key man.

Leaders are born, we often say, but it is truer to say that they are made. They are made by conditions, by the nature of efforts to be exerted, the obstacles to be overcome, the opposition to be faced, and by methods which must be used to win success. No longer should the dispenser of easy favors, the good fellow, and the champion promisor, be the chief administrator. Nor should the man who is best with his fists, who can curse the vilest, or say the most. The railroad needs leaders who can think, those who exercise candor, understanding and reciprocity. This is the needed type of foremanship.

Chief among the problems of the foreman is his management of men. He must have an increasing interest in the problem of hiring, placing, training and retaining workers and must get close to them and their problems. He must select and build up his working force, securing men willing to work and reliable, stable and co-operative. Employment should hold out a future for those who mean to stay and make good. Employment should cease to be a gamble. Incentives must be offered to make labor stable and contented, for the great turnover of labor in the past has proven very expensive. Careful study of how to conserve labor so that it will pay adequately for the investment in it, is far better than reckless hiring and firing of workers. Labor turnover is a human waste.

No place for sugar-coated pills

The railroad is not the place either for too much sentiment or too much system. A policy that is not good for the railroad is not good for the men. Labor unrest means lower output. The contact between management and men should be such as to give all concerned a feeling of security in the motives of each other. Each side must help the other, being frank in both the written and unwritten policy of the management. Misunderstanding must give way to a clearly defined policy of security. Unless this is true, labor is a necessary drudge endured for wages, or a bad tasting pill, sugar-coated by wages. Most men have a hunger for consideration, approval and eminence. This is source of gratification that, if denied to the worker, may be a greater germ of irritation than longer hours and smaller wage. He enjoys submission to the right kind of a foreman, as men always have to good kings and great leaders.

A perfect fit of work to workers cannot be guaranteed, but it is true that a job is never really filled until an employee is found who fits that job in the sense of being able to do it reasonably well and get a reasonable satisfaction from it.

Demand an honest day's work

Many foremen seem to be afraid to demand that men give an honest day's work. They fear overproduction and cut in forces. These foremen need working over. The

*Submitted in the *Railway Mechanical Engineer* competition on the foreman and his responsibilities.

labor market is once more a buyer's market and it is not necessary for the employers to cajole labor into granting an increased output. The pressure of economic forces tends to force workmen to produce more, to be steadier at work and more docile to the management. The working employee is more contented than the one who finds a little idle time. With increased taxes and numerous cuts in rates, the railroads must meet the problem of greater economy in operation. It is not a problem of giving men more work than they can do, but of demanding a personal application of every man to his job.

Foremen must analyze methods of doing work. Is each job being done right? Recently a foreman who started analyzing the jobs under him found that thirty per cent more man-hours were being used on each job than was necessary. This study saved the company ten thousand dollars a year. As we analyze the jobs it helps us match workers' abilities against the requirements of each job.

Sizing up new men

As new men are hired, the foremen should answer for himself two simple questions: "Will the applicant suit the job?" and "Will the job suit the applicant?" Getting the right person on every job, from the laborer to the president is very essential. Know the new man before he gets on the pay-roll. Too many foremen ask the applicant how many years' experience he has had, and let it go at that, having the secretary write up his application. This method is wrong. His labor policies may not be for the good. Better hand him the application blank to fill out. When this is done, ask him some questions as you read his application. Is he inclined to tell more than asked? Recently an applicant voluntarily told how he and another workman almost railroaded the foreman.

The application blank tells you about the experience of the applicant. The way he has filled out the application tells you about his education, but it takes an interview to know the applicant. This is important. True, you may dismiss a poor employee, but every turnover is expensive. If you are too busy at the moment set a definite time to interview the applicant.

In sizing up the man it is important that you learn his experience and education, his knowledge of work, general value to the company and his physical qualities.

Most railroad foremen have been much neglected so far as their training in foremanship is concerned. Most of the teaching has a tendency to become dogmatic, and the rules become bigger than the object of the rules. The adherence to rules made by small men often paralyzes a railroad's activities. Executives of the smaller caliber frequently so plan the work that it is almost impossible to perform it in the best manner. Frequent investigation shows that in railroading there are times when the initiative of the man on the job is of more value to the railroad than some of the iron-clad rules. A code elastic enough to cover any emergency should be the limitation placed on the foreman.

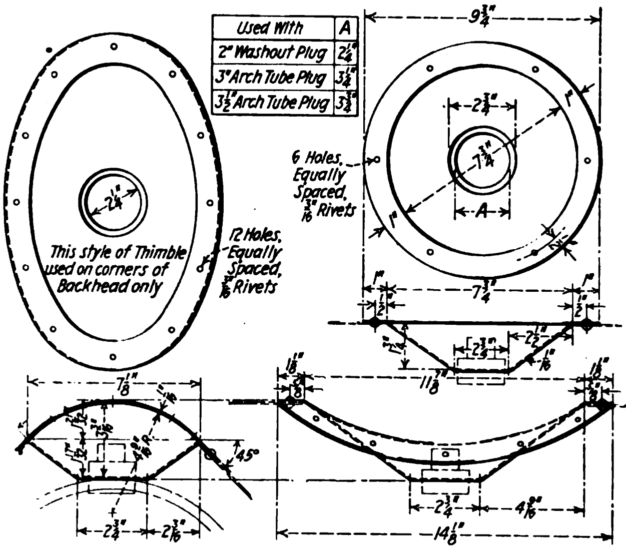
The business of the foreman is production, and the management has every right to expect it; in demanding so much of the foreman, the management must give more than the oft neglected support.

RAILROADS in Wisconsin have petitioned the Federal court at Milwaukee, Wis., for an injunction restraining the state of Wisconsin from enforcing the law, recently passed, requiring the installation of mechanical stokers on large locomotives. The mechanical stoker law was enacted by the 1925 legislature after a contest in which the passage of the bill was supported by railway labor organizations.

Jacket thimble for washout plugs

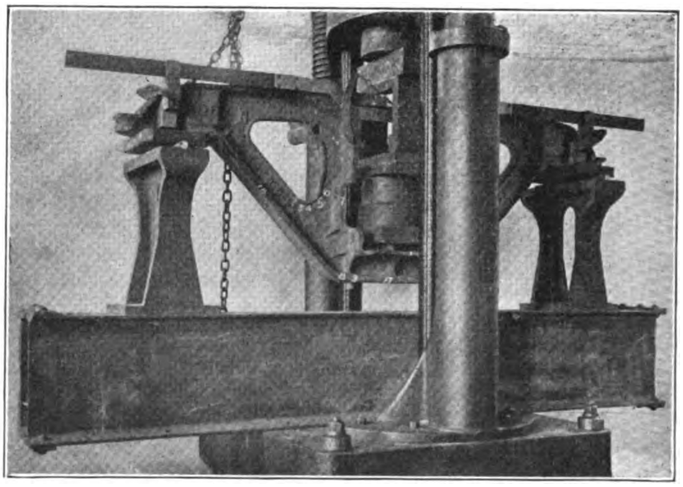
A DESIGN of jacket thimble for washout plugs which has been adopted as standard by the Union Pacific is shown in the drawing. Two styles are shown, one for application to the flat sheets on the back head and also for the slightly curved sheets on the sides of the firebox, and the other for application to the corners of the back head. These thimbles are riveted securely to the jacket.

The feature of these thimbles is that they enable the workman to use either a box or open-end wrench without any possibility of damaging the jacket, as is quite frequently the case when the ordinary type of thimble is used.



Drawing showing the detail dimensions of jacket thimbles for backhead corners and sides of firebox

The boiler of the Union Pacific three-cylinder 4-10-2 locomotive, No. 8000, which was described in the September, 1925, issue of the *Railway Mechanical Engineer*, page 557, is equipped with this type of thimble.



Cast steel truck side frame mounted in a 300,000 lb. testing machine at Purdue University

The tests were for the purpose of determining the character, whether tension or compression, and amount of stress in the various members of the side frame.

Examples of recent locomotives of the 4-8-2 type

Arranged in order of weight

Railroad	B. & O.	E. P. & S. W.	R. F. & P.	D. L. & W.	C. R. I. & P.	So. Pac.	I. C.	C. B. & Q.	A. T. & S. F.	N. Y. C.	Gt. Nor.	G. T. W.	U. S. R. A.	U. P.	C. of Ga.	U. S. R. A.	N. C. & St. L.	F. E. C.
Road class or number	T	L-1s	201	1401	M-50	MT-1	MT	B-1-A	3700	2700	P-2	U-1-C	Heavy	MT	1679	Light	J-1	427
Builder	R. R.	Amer.	Amer.	Amer.	Amer.	Amer.	L. & A.	Lima	Bald.	Amer.	Bald.	Bald.	A. & B.	Amer.	Amer.	A. & B.	Bald.	Amer.
Ordered or built	1925	1924	1923	1923	1923	1923	1924	1922	1924	1925	1923	1925	1918	1924	1923	1918	1925	1924
Tractive force, engine, lb.	65,000	61,300	57,500	58,000	47,900	57,500	51,000	52,750	54,100	60,000	58,830	49,600	58,000	54,838	47,800	53,900	53,800	44,000
Tractive force, booster, lb.	.....	.....	.....	.....	.....	10,100	.....	.....	.....	12,700	.....	.....	.....	.....	.....	.....	.....	.....
Cylinder horsepower (Cole)	3,406	3,182	2,965	2,824	2,683	2,965	2,824	2,755	2,824	2,953	3,030	2,556	2,824	3,030	2,493	2,624	2,624	2,434
Speed m.p.h. at 1,000 ft. piston speed	44.02	43.75	43.45	41.08	47.2	43.75	46.55	44.02	44.03	41.08	46.55	43.45	41.08	46.55	44.03	41.08	41.08	46.55
Weight of engine, lb.	400,000	390,000	381,000	376,000	368,500	368,000	367,500	364,000	361,600	359,000	357,000	354,110	352,500	338,000	326,500	327,000	326,950	318,000
Weight on drivers, lb.	275,000	261,500	262,000	257,500	252,500	246,000	247,000	245,000	246,300	240,500	238,000	231,370	243,000	224,000	214,500	224,500	217,970	214,000
Weight on front truck, lb.	62,000	65,500	56,500	58,500	58,000	61,500	57,500	60,000	62,300	60,500	59,500	61,590	51,500	60,000	60,000	49,500	52,330	54,000
Weight on trailing truck, lb.	63,000	63,300	62,500	60,000	58,000	60,500	63,000	59,000	53,000	58,000	59,500	61,150	57,500	54,000	52,000	53,000	56,650	50,000
Weight of tender, lb.	259,300	251,000	201,600	217,300	196,000	224,000	205,300	205,800	242,900	275,000	235,000	250,490	195,500	247,800	187,300	192,000	192,050	255,900
Wheel base, driving, ft. and in.	19—3	19—6	20—0	18—9	19—10	20—0	19—6	19—3	18—0	18—0	19—0	19—6	18—3	19—6	18—0	18—3	18—3	19—7
Wheel base, engine, ft. and in.	41—4	43—7	42—2	41—0	42—1	42—3	42—3	41—7½	38—11	42—0	41—7	41—9	40—0	41—3	38—11	40—0	40—10	42—2
Wheel base, eng. and tender, ft. and in.	89—0	83—4¼	81—9	77—2	79—1	83—6	77—8½	79—5	76—9⅝	84—7	80—0½	80—3¾	75—8½	79—11½	73—9½	75—8½	76—7	81—11⅝
Cylinders, diameter and stroke, in.	30x30	29x30	28x30	28x30	28x28	28x30	26x28	27x30	28x28	27x30	29x28	26x30	28x30	29x28	27x28	27x30	27x30	26x28
Driving wheels, diameter, in.	74	73½	73	69	74	73½	73	74	69	69	73	73	69	73	69	69	69	73
Steam pressure, lb.	210	210	210	200	190	210	200	210	200	225	200	210	200	200	190	200	200	200
Fuel	Bit. coal	Bit. coal	Bit coal	Bit. coal	Bit. coal	Oil	Bit. coal	Lign.	Oil	Bit. coal	Oil	Bit. coal	Bit. coal	Oil	Bit. Coal	Bit. Coal	Bit. Coal	Oil
Boiler, diameter first ring, in.	90	84½	82½	84¼	80	82 7/16	82	78	82	82 7/16	84	82 7/16	86	82½	75	78	78	74⅝
Firebox, length, in.	132¼	126⅛	120	120⅛	108⅛	120	120⅝	116⅞	122¼	120⅛	132	114⅛	114⅛	126	114⅛	120⅛	120⅛	114⅛
Firebox, width, in.	96	96¼	90	96	84	90	90	96	84¼	90¼	96	84¼	96¼	96	84¼	84¼	84¼	84¼
Tubes, no. and diameter, in.	269—2¼	234—2¼	223—2¼	285—2	216—2¼	223—2¼	220—2¼	198—2¼	254—2¼	219—3½	232—2¼	188—2¼	247—2¼	239—2¼	178—2¼	216—2¼	190—2¼	181—2¼
Flues, no. and diameter, in.	48—5½	50—5½	45—5½	50—5⅜	45—5½	45—5½	45—5½	45—5½	43—5½	.....	50—5½	40—5½	45—5½	48—5½	36—5½	40—5½	45—5½	36—5½
Length over tube sheets, ft. and in.	23—0	22—0	22—0	21—0	22—5	21—6	22—0	22—0	21—0	20—6	22—0	22—3	20—6	22—0	21—6	20—6	20—6	22—0
Grate area, sq. ft.	89.17	84.3	75	80.4	63	75	75.4	77.9	71.7	75.3	88	66.7	76.3	84	66.8	70.3	71.1	66.8
Coal rate, lb. per sq. ft. grate per hr. (Cole)	124	123	128	114	138	127	122	115	128	127	112	125	120	117	121	117	120	119
Steam required per hr., lb. (Cole)	70,800	66,200	61,700	58,700	55,800	61,700	58,700	57,300	58,700	61,400	63,100	53,100	58,700	63,100	51,900	54,600	54,600	50,500
Heat. surface, firebox, total, sq. ft.	383	459	388	389	394	350	442	381	359	356	400	307	373	345	329	348	408	340
Heat. surface, tubes and flues, sq. ft.	5,208	4,599	4,297	4,590	4,283	4,202	4,258	3,976	4,425	4,095	4,571	3,731	4,293	4,598	3,354	3,773	3,608	3,472
Heat. surface, total evap., sq. ft.	5,591	5,058	4,685	4,979	4,677	4,552	4,700	4,357	4,784	4,451	4,971	4,038	4,666	4,943	3,683	4,121	4,016	3,812
Superheating surface, sq. ft.	1,305	1,390	1,190	1,292	1,247	1,162	1,227	1,100	1,092	1,985	1,368	1,048	1,085	1,331	961	966	1,145	944
Comb. evap. and super. surface, sq. ft.	6,896	6,448	5,875	6,271	5,924	5,714	5,927	5,457	5,876	6,436	6,339	5,086	5,751	6,274	4,644	5,087	5,161	4,756
Tender, water capacity, gal.	15,100	12,000	10,000	12,000	10,900	12.000	10,000	10.000	12,000	15,000	12,000	12,350	10,000	12,000	9,500	10,000	10,000	12,000
Tender, fuel capacity, tons or gal.	18	18	16	14	16	4.000	18	20.8	4,000	18	5,000	18	16	5,200	15	16	16	5,000
Weight on drivers ÷ weight eng., per cent.	68.75	67.0	68.8	68.5	68.5	66.8	67.2	67.4	68.2	67.1	66.7	65.33	69.1	66.3	65.6	68.7	67.0	67.4
Weight on drivers ÷ tractive force	4.23	4.26	4.55	4.44	5.27	4.28	4.83	4.64	4.55	4.01	4.34	4.66	4.19	4.08	4.49	4.17	4.07	4.86
Weight of engine ÷ cylinder hp.	117.4	122.5	128.5	133.0	137.3	124.0	130.0	132.2	128.0	121.5	117.8	138.5	124.5	111.5	131.0	124.5	124.5	130.6
Weight of engine ÷ comb. h. s.	58.0	60.4	64.9	60.0	62.2	64.4	62.0	66.7	61.5	65.8	66.5	69.6	61.3	53.9	70.3	64.2	63.4	66.9
Comb. heat. surface ÷ cylinder hp.	2.02	2.02	1.98	2.22	2.21	1.93	2.10	1.98	2.08	2.18	2.09	1.99	2.03	2.07	1.86	1.94	1.97	1.95
Tract. force ÷ comb. heating surface	9.44	9.51	9.80	9.26	8.08	10.07	8.60	9.68	9.21	9.32	9.65	9.76	10.08	8.74	10.28	10.59	10.43	9.26
Tract. force × dia. drivers ÷ comb. h. s.	699	698	715	638	596	740	628	716	635	643	631	712	696	638	710	731	720	676
Cylinder hp. ÷ grate area	38.2	37.8	39.5	35.1	42.6	39.2	37.5	35.4	39.3	39.2	34.4	38.3	37.0	36.1	37.3	39.5	36.9	36.5
Comb. heat. surface ÷ grate area	77.4	76.5	78.4	78.0	94.0	76.2	78.6	70.1	81.9	85.5	72.1	76.2	75.4	74.7	69.6	72.4	72.6	71.2
Firebox surface ÷ grate area	4.30	5.45	5.17	4.84	6.25	4.63	5.86	4.89	5.01	4.73	4.55	4.61	4.90	4.11	4.93	4.95	5.74	5.09
Firebox surface, per cent evap. h. s.	6.86	9.07	8.29	7.81	7.91	7.69	9.40	8.75	7.50	7.90	7.16	7.61	8.0	6.99	8.94	8.45	10.16	8.92
Superheat. surface, per cent evap. h. s.	23.51	27.36	25.40	25.90	26.65	25.53	26.20	25.26	22.80	44.60	27.53	25.92	23.26	26.93	26.10	23.44	28.54	24.76
Notes	..	a-d-e	a	a	a-d	a-g	a-d	b	b	a-e-g-k	b	b-e	b	a	a-d-e	b	b-d	a-d

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; d—Syphon; e—Feedwater heater; g—Booster; k—Type E superheater.

Firing for smoke prevention and maximum efficiency*

By A. T. Mitchell,
Chief smoke inspector, Pittsburgh District, Pennsylvania Railroad

ALL Pennsylvania locomotives in shifting, work train and interchange freight service use low volatile coal exclusively in the Pittsburgh district. Each locomotive in passenger and freight service, working out of a Pittsburgh enginehouse, is supplied with 1,000 lb. of low volatile coal on the front of the tank to keep the fire in proper condition while lying at the enginehouse, to build the fire for the road and to aid in preventing smoke while the engine is in what is called the "smoke district." This low volatile coal is loaded after the fire has been cleaned or built, and the amount, 1,000 lb., has been found to be sufficient, although there is now under consideration the possibility of extending its use to local trains serving the suburban towns near Pittsburgh. Low volatile coal is used also in all power plants in the city whose boilers are fired by hand.

Engine house operation building fires

In the building of new fires at the enginehouses, two methods of lighting are used and two methods of furnishing draft.

In the first method the grates are covered with from six to eight inches of high volatile coal, on top of which is placed four to six inches of low volatile coal; a bag of wood shavings saturated with oil is spread over the coal and the house blower attached. The fire is then lighted, with the blower turned on sufficiently to keep down the smoke and to carry the fire over the entire firebox area—if the blower is turned on full at first, it is likely to carry some of the shavings out of the firebox. Air is admitted also through the fire door while the saturated shavings are burning. The amount of oil to be used, the regulation of the blower and the admission of air through the fire door are matter of judgment on the part of the operator; lighting off is therefore an operation requiring training and experience. As the coal ignites, the fire door is closed and the blower fully opened. The object in this method of building the fire "upside down" is to have all of the volatile matter, as it is distilled from the coal, pass through a zone of fire where it will be completely oxidized and not pass into the atmosphere as smoke. If the operations of building, lighting and supplying with air have been properly carried out, no more coal should be needed; however, in case it is necessary to supply an additional amount, low volatile coal only is used.

The second method of lighting fires is with the use of an oil burner, the oil being supplied under pressure and properly mixed with air before reaching the bed of solid fuel. The preparation in this method is the same as in the other; it is possible, however, with the use of the oil burner to raise steam in less time than with the first method. Here, also, training and experience are necessary, as there is possibility of injury to the firebox and flues if steam is advanced too rapidly in a cold boiler. Sufficient air is admitted to insure complete combustion, and the air pressure on the burner is sufficiently high to drive the flame through the coal. The house blower is used fully open and the fire lighted from front to rear of the firebox.

To furnish necessary draft, there are steam blower lines and fans. All enginehouses are equipped with steam blower lines, and in addition, those at the Scully and Pennsylvania avenue enginehouses have electrically driven fans, which are 10 ft. in diameter and are driven by 110-hp. motors at a speed of 240 rev. per min., furnishing a draft equivalent to 3½ in. of water at the base of the enginehouse stack, and 1½ in. at the point furthest from the stack.

From the base of the stack there is a duct extending around the enginehouse; between each pair of stalls there is an upright jack connected at one end with the duct and having two arms with hoods which fit over the stacks of locomotives. These jacks are equipped with dampers in order that the draft may be regulated at the locomotive. They are also equipped with periscopes so that if dense smoke shows at the top of the large stack, it will be possible to determine which locomotive is at fault. The steam blowers at Scully and Pennsylvania avenue enginehouses are used only in emergencies, which have been found rarely to occur; and as each of these enginehouses has two fans, it is planned to remove the steam lines entirely.

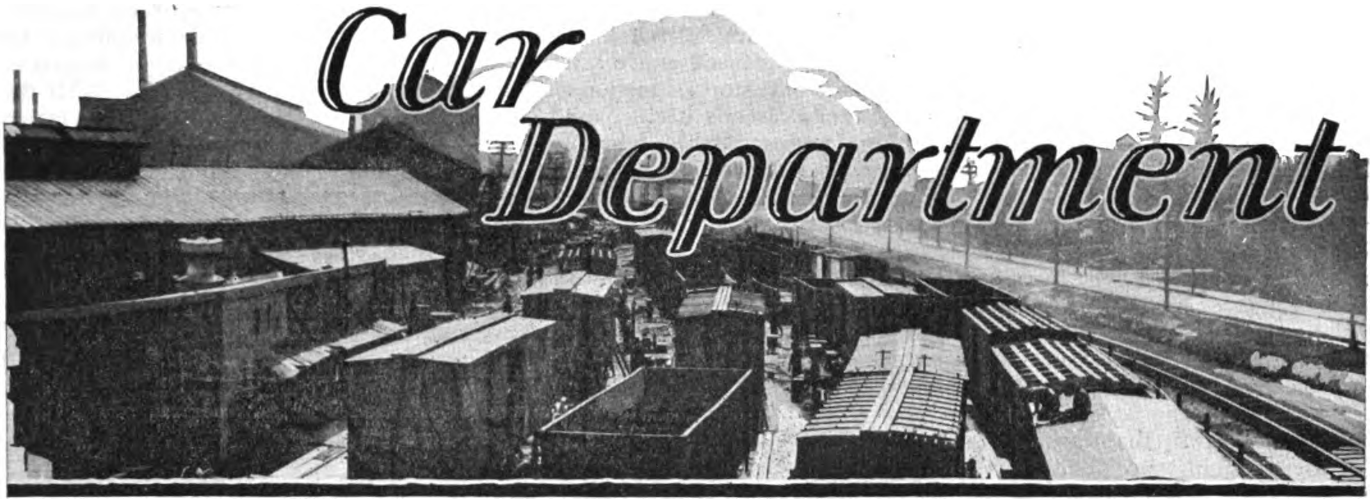
*Abstracts from an address delivered at the annual convention of the Smoke Prevention Association held June 17-20, inclusive, at Grand Rapids, Michigan.

Cleaning fires

The work of cleaning fires begins on the road. A fireman is expected to bring his fire to the enginehouse without any green coal, and with enough live fire for cleaning. Any infraction of this rule is reported. There should be not less than 150 lb. of steam nor less than three scant gages of water. The engine, after being inspected, is placed over the ashpit. The method of cleaning then depends on the position of the drop grates. If there is a drop grate at the front and one at the rear, the fire is pulled back from the front of the firebox and the front grate dropped. After the front of the firebox is cleaned of ash and clinkers, the drop grate is put up and the grates covered with coal. Live fire is then pushed forward over the top of this coal, the back grate dropped and the rear of the firebox cleaned. Green coal is then placed on the grates and live fire pulled back over the top. Only low volatile coal is used after this time. An engine with one drop grate only is cleaned one side at a time, but under no circumstances should live fire be placed on the grates and green coal on top. The coal should be placed on the grates and the live fire on top, so that all volatile matter distilled will pass through a zone of fire. The blower should be regulated as necessary to prevent smoke.

Banking fires

After the fire is built and steam raised at the enginehouse, the engine is moved to the coal tipple and supplied with coal, including either a full supply or 1,000 lb. of low volatile coal, according to the service. It is taken then to the enginehouse or storage yard, where the fire is banked until the crew takes charge. In banking, one of two methods is used; if the engine is equipped with an arch, the fire is kept heaviest near the door. If there is no arch, the fire is heaviest against the flues. All fires are banked with low volatile coal, which is dampened before being put into the firebox. The coal is allowed to coke and the steam pressure is kept above 100 lbs. and three scant gages of water maintained, so that there will be sufficient fire in the firebox, that when the crew takes charge, it is necessary for the fireman only to open the blower slightly and advance the steam pressure, filling with low volatile coal any holes which may have burned in the fire. The engine is then ready to be taken to the station, where no firing is permitted except in case of emergency, and it is expected that the fire has been so prepared that the emergency will not occur.



Causes and prevention of freight car derailments

Truck springs, car lading and truck design contributing factors which should be controlled by proper design

By T. H. Symington
President of The Symington Company, Baltimore, Md.

IN this article derailments occasioned by defective track will not be discussed; only those that in my opinion can be prevented by simple improvements in car design.

It is well known that in England track is laid square, that is, with the joint of one rail opposite the joint of the other rail. In this country track is laid diagonal, that is, the joint of one rail is opposite the middle of the opposite rail. On some railroads in this country it is proposed that the track be laid dissymmetrical, that is, with the rail joint on one side opposite a third or a fourth of the other rail length.

The reason for this suggestion is to break up the synchronization with the rail joints, on both sides of the track, of the pendulum roll of high capacity, high gravity cars. Freight cars, particularly high gravity cars, supported on coil springs which give out as much work as is put into them, roll from side to side with a pendulum action, and the timing of this roll is constant, regardless of the extent of the roll, which is a fundamental law of the pendulum. This roll synchronizes with the regular intervals of the diagonal rail joints at certain definite speeds, dependent on the design and lading of the car. When the pendulum swing of the car body coincides with the rail joints, so as to increase this roll, it becomes cumulative owing to the regular impulses caused by the slight depressions of the rail joints on both sides of the track, except where the track is in perfect surface.

With the track laid dissymmetrically, these evenly timed impulses causing an increase of the pendulum roll at the synchronizing speed for any car, would come from the rail joints on one side of the track only, and their frequency would, of course, be cut in half; but the opportunity for coincidence between the pendulum roll and the rail joints on one side or the other of the track, would be double. It is possible, however, that dissymmetrical rail joints would entirely break up the tendency to excessive rolling of the car body.

This cumulative roll from one side to the other results in the bolster springs going solid at times, and I venture to say that there is no high gravity 50-ton or 70-ton car in this country that has not, at some time, had its springs go solid under conditions favorable for the development of cumulative roll.

The part truck springs play in causing derailments

The A.R.A. standard 50-ton car spring is designed to go solid at 64,000 lb. and the 70-ton car spring at 80,000 lb., and it must be evident that these springs are often worked through a large range from practically no stress to a stress that will close them solid. This large working range of the truck spring results in its early failure through fatigue, or by its taking a permanent set which proportionately reduces its capacity. When the truck spring goes solid, there is always a localized bending moment somewhere in the coil, with an excessive resultant fibre stress, frequently causing the spring to break at this point. Truck springs on 50-ton and 70-ton freight cars are, therefore, giving general trouble.

The problem is difficult, because the height of the spring between the truck frame and the bolster is only 8½ in., which is a small space for a different design of spring, and the width of the window opening in the truck frame limits the designer in this direction. Also, the necessity for interchangeability with the A.R.A. standard increases the difficulty of the problem.

Some railroads that have had very large breakages of springs under 50-ton and 70-ton cars, are trying to solve

this problem by making a stiffer coil spring of higher capacity, with a resulting reduced travel. These springs apparently help the problem of spring breakage because of the lower fibre stress in the steel, but they do not stop the car roll so as to prevent derailments. Other railroads are approaching the problem from the angle of preventing derailments, and they seem to want a spring of increased travel over the standard. This design necessarily increases the fibre stress in the steel, when the spring goes solid, and we can expect a shorter life for this spring, if we cannot in some way stop excessive car rolling.

It is my opinion that the present A.R.A. standard spring would be satisfactory if its normal working range could be reduced. There is only one way of doing this, and that is to stop the rolling of the car body.

Excessive rolling at the present critical speeds can be stopped by laying the track in a dissymmetric manner, thereby breaking up the synchronization between the pendulum roll and the rail joints. All rolling can be stopped by developing a spring that has not a straight line action under compression and release, or in other words a spring that will absorb work and give out less energy than is applied to it.

The chart shown here illustrates the thought. Line *A-B* represents the compression and release curve of the A.R.A. 50-ton class D spring, and line *A-C* represents the compression and release curve of the 70-ton class H spring. Line *A-D* represents the compression and release curve of the higher capacity lesser travel spring that has been developed to minimize the breakage of springs on 50-ton cars, and *A-E* the curve for the same type of spring on 70-ton cars. Line *A-X* represents the compression and release curve of the longer travel spring for 50-ton cars and line *A-Y* the curve for the same type of spring for 70-ton cars.

What is needed, in my opinion, for a 50-ton car spring is a release line *B-F-A,* and for a 70-ton car spring a release line *C-G-A,* which would break up the roll of the car, regardless of the way the rails are laid.

In this connection it is well to realize that uncushioned shocks are most destructive, and result in broken axles, broken truck frames, broken and bent rails and the pounding of rail joints out of surface. It would certainly seem desirable to have, in addition to the suggested release curve for the 50-ton and 70-ton springs, a yielding peak of high capacity at the end of the travel of the standard 50-ton and 70-ton car springs, to take the uncushioned shock off the truck frames and track, in the event of these springs ever being fully compressed. The peak referred to is indicated by the line *H-J* for the 50-ton spring, and the line *K-L* for the 70-ton spring.

Referring to track conditions, it is well known that the superelevation of the outer rail on curves is a compromise. It is not high enough for high speed passenger service, and it is too high for slow speed freight service.

Relation of track conditions and car lading to derailments

It may not be generally known that when the high gravity, high capacity car is standing on a curve with a superelevation of 5 in. for the outer rail, there is 25 per cent more weight on the inner rail than normal, and 25 per cent less weight on the outer rail than normal. This unbalanced load condition on the rails will vary with the open top car and the stiff closed top car, when only one truck is on the curve.

Many flexible open top cars can be blocked up on their four corners, and then one corner can be jacked up as much as 14 in. before another corner will leave its blocking. This is not true of a stiff closed top car. Therefore, in the flexible open top car the lading can be considered as divided into three parts, one over each truck, and one part in the center of the car. The excess weight on the inner rail on a curve with the open top car is largely a function of the lading in one end of the car. With the stiff closed top car the excess of load on the inner rail is a function of the weight of the entire lading of the car.

In my opinion the rolling mass of the loaded car is the principal factor in derailments. If on a 5-in. superelevation curve the static excess weight on the inner rail is 25 per cent above normal, what must be the proportion of weight on the inner rail when the car body is rolling inward, due not only to the shifting of its center of gravity toward the inner rail, but due also to the momentum of this mass, particularly when the truck springs go solid

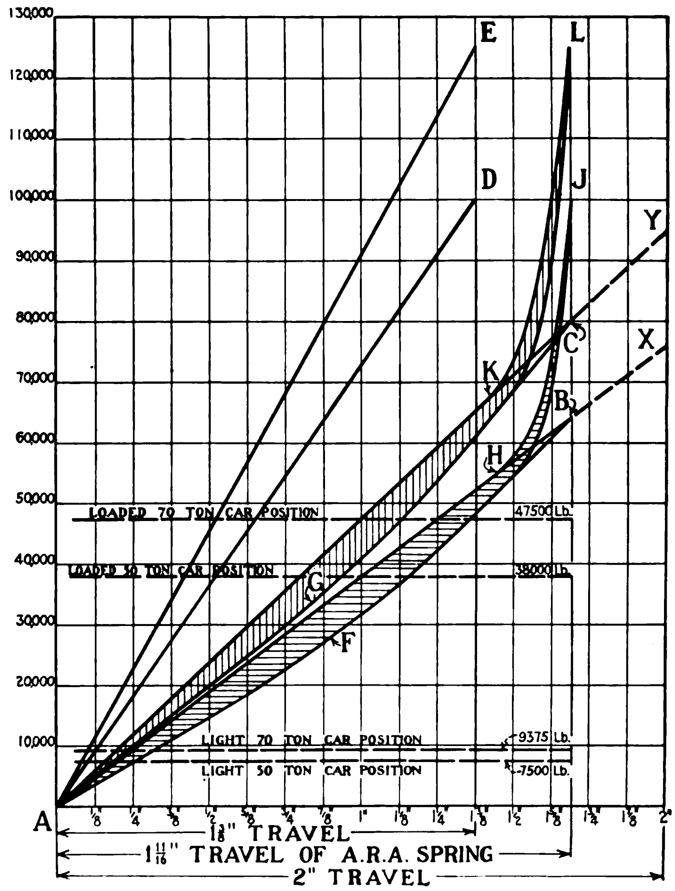


Chart showing the spring characteristics suggested for 50-ton and 70-ton cars

over the inner rail? This, of course, coincides with a corresponding reduction in weight on the outer rail.

There are no sudden high spots in railroad track. Defects in surface are all low spots, and one theory is that we need soft, long travel truck springs that will push the truck wheels down into the low spots. If this theory were entirely sound, cars running light without load would be more apt to leave the track, because under the light car the standard springs are very slightly compressed. That this theory does not fully explain the problem, is proved by the fact that far more loaded cars leave the track than light cars. I believe that some unloaded cars of special truck design have been derailed, because of forces not incident to the conventional four wheel truck.

In my opinion this is what happens in derailments. When the roll of the high gravity car synchronizes with the rail joints, the roll becomes excessive, and the pendulum swing increases to an amount that causes the car truck to fulcrum on the wheel treads on the inner rail,

and lift the outside forward wheel flange over the top of the outer rail.

Unfortunately when a car is on a curve the whole tendency of the wheels on the inner rail is to go ahead of the wheels on the outer rail, because the inner rail is shorter than the outer rail, resulting in the crowding of the outside front flange against the outside rail. Therefore, we have an ideal condition for derailment of the front outside wheel, because at the same instant the weight is taken off this wheel, it is forced against the rail so that it can easily climb over.

It must be evident, also, that when the car body has reached the limit of its swing towards the inner rail, the side bearings are in contact on the inside, and there is twice the normal side bearing clearance between the body and truck bolsters on the outside, so that the car body itself offers no resistance at the outer side bearing to prevent the outside wheels from lifting.

Freight car trucks should be rigid

It is unfortunate that the center and side bearing friction between the truck and body bolsters increases the tendency of the wheels on the outer rail to lag behind the wheels on the inner rail, when entering a curve, thereby increasing the pressure of the outer front flange against the rail, resulting in an increased tendency tor this flange to climb over the rail.

There must be some slippage of wheels on a curve, with resulting friction, when any forces prevent the coning of the wheels from adjusting these wheels to their proper position on the rails, to avoid the slippage. The spring plank is the only means for holding the truck side frames square with each other so as to minimize this wheel and rail slippage friction. The spring plank resistance, consequently, must overcome both wheel and rail frictional slippage resistance, as well as center plate and side bearing frictional resistance. The total amount of these resistances has been established by test.

If the center plate and side bearing frictional resistance is minimized on a curve, the spring plank will hold the truck nearer square, and therefore reduce the pressure of the front wheel flange against the outside rail, and reduce the frictional resistance between this wheel flange and the rail. While the center plate and side bearing friction tend to hold the truck out of square on entering or while in a curve, this center plate and side bearing friction exert a force tending to square the truck when coming out of a curve, and it may be that we need some force of this character to help prevent the outside truck frame from continuing to lag behind the inside frame, when the car has come out of a curve on to a tangent.

Cars are held on the rails by the wheel flanges only, and these wheel flanges under the 50-ton and 70-ton cars of today have exactly the same height as the flanges under cars of 20 tons capacity 40 years ago. Furthermore, the track gage of 4 ft. 8½ in. under our big cars, is exactly the same as it was under the 20-ton cars.

It has been demonstrated that a rigid four wheel truck prevents the two inner wheels from going excessively ahead of the two outer wheels, resulting in less rail and wheel flange friction; but it is not possible to make our modern freight car trucks absolutely rigid in this respect. The A.R.A. truck is comparatively rigid because of the bossing of each side frame into the spring plank at four points. With a swiveling spring plank, the inner side frame is prevented from going excessively ahead of the outer frame by the unmechanical cramping of the truck bolster in the side frames, or by the unmechanical cramping of the axle ends in the journal boxes, dependent on the local clearances in each individual truck. Under these conditions, there is either rapid wear of the bolster and side frame pedestal ways, rapid wear with heating of journals and brasses, or both.

Suggestions to prevent car derailments

We cannot today change our wheel flanges, the gage of our track, the longitudinal flexibility of our trucks, or the large inertia forces incident to our high capacity, high gravity cars. We cannot lay our rails in a dissymmetric manner to break up synchronization without prohibitive expense. We, therefore, are confined to what we can do with the cars themselves. In my opinion we can prevent derailments by lowering the center of gravity on new cars, and by designing the springs and car suspension to control the forces causing derailments.

If a car rolls sufficiently to lift the wheels on a straight track, derailments rarely occur, because the wheels normally drop back into their proper positions, with the flanges on the inside of the rails. Therefore our study will be confined to the conditions on a curve. If we prevent a car from rolling on entering or leaving a curve, we will, of course, prevent its rolling on straight track.

1—The first and most obvious improvement for high gravity cars is to put a spring of elliptic work-absorbing action under freight cars, with a curve of compression and release somewhat similar to lines *A-B-F-A*, or *A-C-G-A* shown in the chart. Of course this spring must be interchangeable with the present A.R.A. standard spring, and its fibre stress must be low enough to insure a reasonably long life for the spring.

2—As far as possible we should minimize center plate and side bearing friction, to prevent excessive pressure of the front outside wheel flange against the rail, which causes derailments, excessive wheel flange and rail wear, and also increases train resistance.

3—We should construct the four wheel trucks as rigid as is practical in the connection between the side frames and the spring plank.

4—We should arrange the spring suspension so that some load is always maintained on the outside wheels, regardless of whether the outside springs are broken, or have taken a permanent set.

It is not practicable to maintain all track in surface and alinement, similar to first class main line track. Therefore, our problem is to design freight car trucks so that they will stay on a track that is reasonably out of surface and alinement.

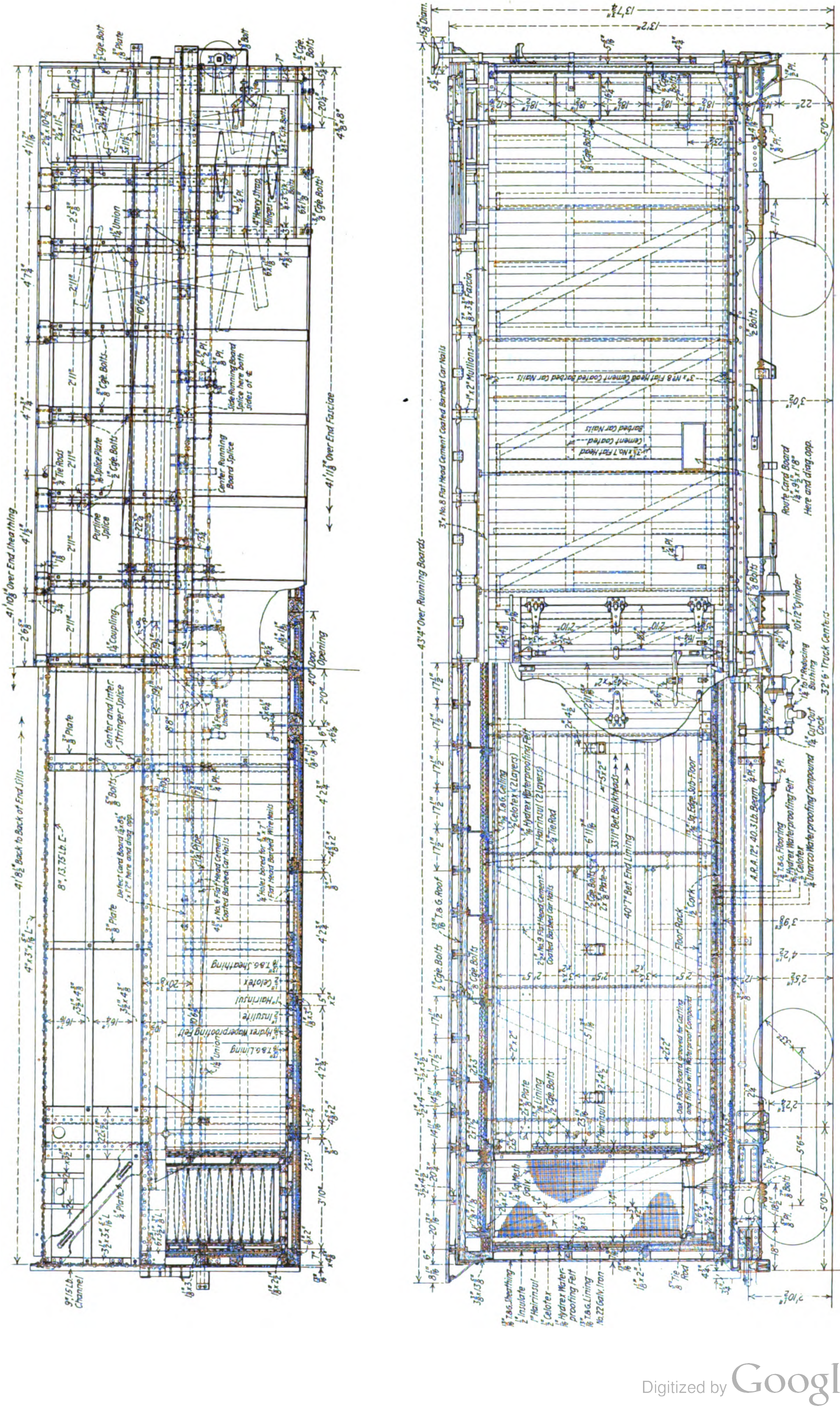
The vertical jiggle of coil springs is largely responsible for coupler and knuckle wear, bolster and side frame pedestal wear, and the tendency of cars to uncouple in fast freight service. The vertical jiggle of coil springs and the excessive roll of the car body are largely responsible for damage to box and refrigerator car roofs.

A freer radial action will not only help prevent derailments, but will minimize rail and wheel flange wear. It has been demonstrated to reduce train resistance on curved track.

A cushioned blow, when the truck spring goes solid, will largely prevent side frame, axle and rail breakages, and make it easier to maintain track in proper surface.

A smooth running freight car, without roll, with no uncushioned shocks, and with free radial action of the trucks, will simplify and reduce the cost of maintenance of all track. The required strength of rails, wheels, axles, side frames, bolsters and car framing, has been developed empirically in service, under excessive shocks, that can be largely reduced, and it is possible that the future freight car can be materially lightened.

It is my opinion that all open top and stiff closed top freight cars can be so equipped in their trucks that they can be operated with safety over the roughest track.



Sectional plan and elevation of the D., L. & W. refrigerator car

Fruit refrigerator cars for D. L. & W.

Insulated and ventilated to afford protection in cold and hot weather—A. R. A. standards closely followed

By P. Alquist

Master car builder, D. L. & W., Scranton, Pa.

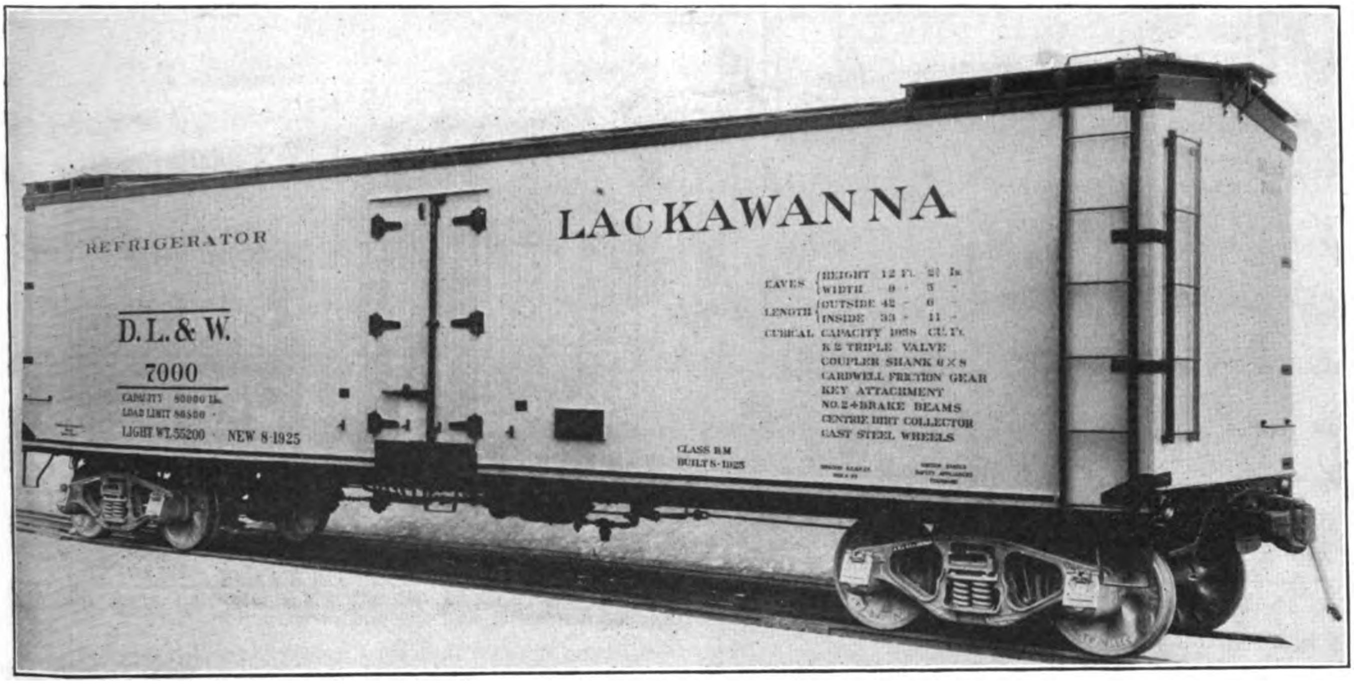
A SHORT time ago the Delaware, Lackawanna & Western received 300 refrigerator cars which represent the latest improvements and A.R.A. standards. These cars were built by the American Car & Foundry Company, at its Berwick, Pa., plant. They are 42 ft. 6 in. long and weigh 55,200 lb.; stenciled capacity, 80,000 lb. These cars were designed for the most difficult requirements of fruit transportation. Bananas are now being received at the Port of New York in a fleet of well insulated vessels. The railroads are called on to transport this fruit during the summer and winter months to distant inland cities in refrigerator cars without the use of stoves en route, maintaining a temperature during the winter months between 55 and 66 deg. F., as bananas will chill below this minimum. This is accomplished by preheating the cars at the ship side by the use of stoves which are removed after the cars are loaded. The condition in which fruit arrives at its destination depends on the construction and insulation of the car, as well as the tight fit of ice hatches and side doors.

During the summer months maximum ventilation is required in order to remove the heat generated by the fruit and to retard ripening. This is accomplished by direct ventilation with maximum air space through the ice hatches and bunkers, eliminating the usual splash board and using high floor racks. In extreme warm weather, long distance shipments require light icing. The cars have hinged floor racks, and sections fold back at the doorway and near the ice bunkers to permit the loading of merchandise on the return movement, if not needed for perishable commodities requiring icing.

The cars are provided with steel underframes consisting of two standard A.R.A. center sills of 12-in. special rolled channels, weighing 40.3 lb. per foot. These are held together by a 3/8-in. by 20-in. cover plate. The side sills are composed of 8-in. shipbuilding channels, weighing 17.6 lb. per foot, with a 3-in. by 4-in. by 5/16-in. angles riveted to the outside to receive the wood side sills to which the side frame of the car is secured. The end sills are made of 9-in. channels weighing 15 lb. per foot, reinforced on the back with 3-in. by 3½-in. by 5/16-in. angles to receive the wooden floor stringers. The body bolsters are of the built-up type with cast steel center fillers. The needle beams are of the built-up type with the top and bottom cover plates ½ in. by 12 in., riveted to the center sill channels and two 5/16-in. pressed steel fillers placed between them with the ends riveted to the side and center sill channels. A 3-in. by 3-in. by ¼-in. angle is riveted to the web of the pressed steel fillers and under the side of the top cover plate.

Each corner of the underframe is reinforced by a 4-in., 8.2 lb. Z-bar diagonal brace. There are also six pressed steel pans 3/8 in. thick, extending from the center sills to the side sill channels, spaced between the needle beams and the body bolster and at the center of the car for additional supports to the wooden floor stringers.

The trucks are of the Bettendorf "U" section type, provided with the Barber lateral motion device. Cast



Lackawanna refrigerator car which weighs 55,200 lb. and has a capacity of 80,000 lb.

steel truck bolsters are used. Davis cast steel wheels, Creco four-point brake beams and Schafer pressed steel "U" type bottom connections with self-locking hangers are used. All the brake pins are fastened with positive brake pin locks.

Body construction

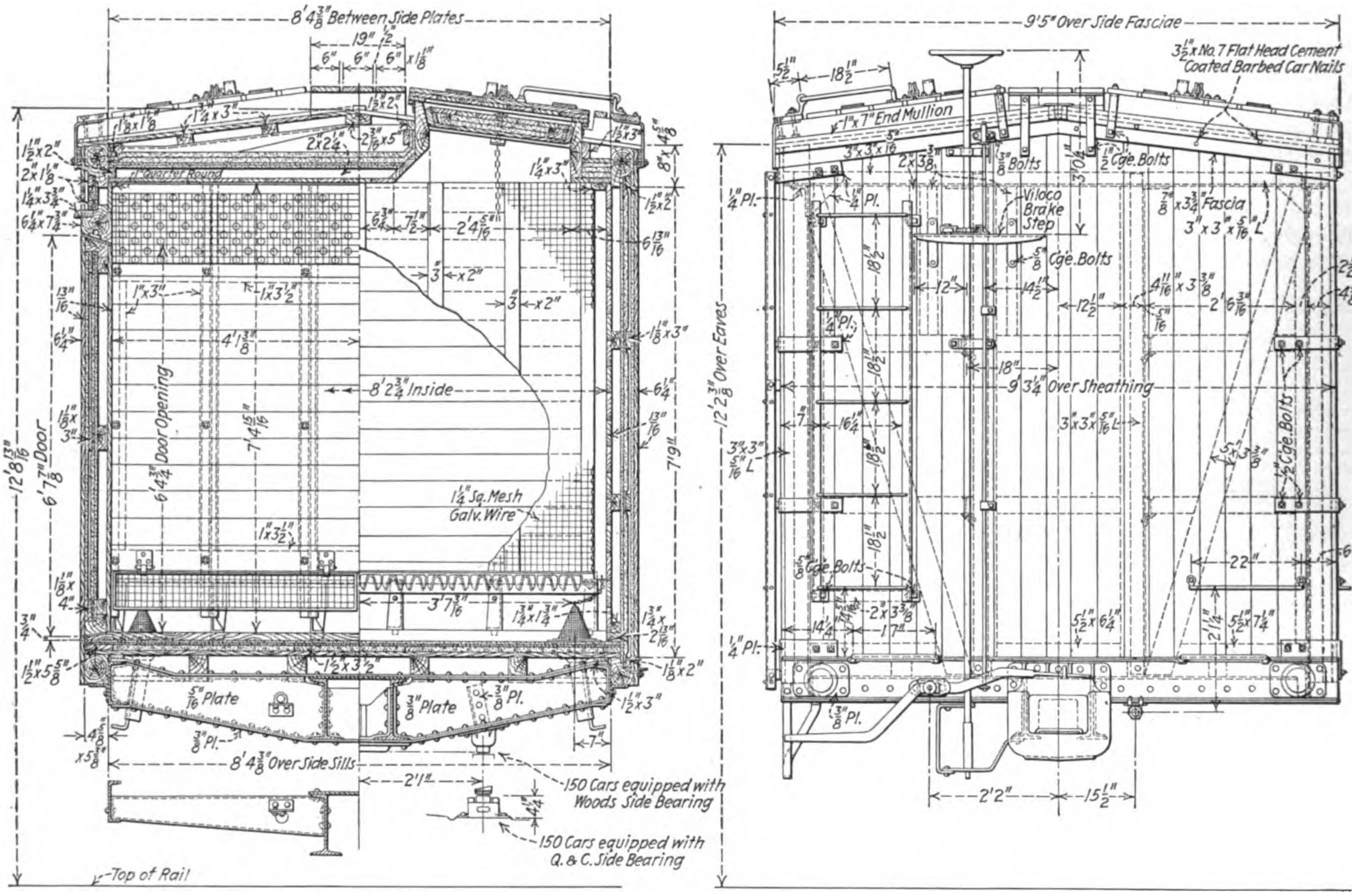
Practically the entire superstructure is built of Douglas fir. The wood side stringers extend from end sill to end sill and are securely bolted with horizontal and vertical bolts to the metal side sills which are attached to the side framing of the car. There are two center and two intermediate floor stringers.

The lower course of flooring consists of 13/16-in. by 5¼-in. rain-tight boards laid in white lead and secured on top of the four intermediate longitudinal stringers and the two side stringers with eight-penny, cement coated, heavy barbed car nails. On top of this is placed a layer

The door posts are of 6-in. by 6¼-in. white oak with the ends fitted into cast steel top and bottom post pockets. The side doors are equipped with Miner refrigerator door fasteners and LaFlare insulation. Automatic open door fasteners of the L. & N. type are used. After the canvas insulation on the doors had been applied, it was coated with equal parts of paraffin and tallow which was applied while hot.

Ice boxes

Equipco all-metal pilferage roof, bulkheads and ice grates, with a specially large opening over the insulated bulkhead are used to insure maximum ventilation. There are four Equipco pressed steel well traps with agitators, one located near each corner of the car and securely riveted and soldered water-tight to the drip pans under the ice box. The drip pans are of No. 14 galvanized iron and extend 6½ in. up and over the special bunker floor boards.



Cross-section of the car showing the method of insulating and the end construction

of Hydrex water proofing felt. Upon this felt is then laid a course of ½-in. Celotex. Over the Celotex is laid 1½ in. of non-void insulation between 1½-in. by 3½-in. nailing strips. This entire surface is then covered with a ¼-in. coat of Unarco weather-proof coating. The upper or main floor is laid of kiln dried decking, 1¾ in. thick by 5¼ in. wide. The edges of the floor are filled in with a weather-proofing compound. The frame work of the roof consists of 13 pressed steel Z-bar and U-section carlines of 3/16-in. material. These are securely bolted to the ridge-pole which is dressed to 2 3/16 in. by 5 in. and shaped on top to conform to the angles of the roof. The fascia boards are 7⅛ in. by 3¼ in. wide with the lower edge formed as shown in the illustration. A No. 22-gage outside flexible metal roof, manufactured by the Standard Equipment Company, is used.

The vertical flanges of the floorpan are back of the No. 22 galvanized iron with which the side and end linings of the ice boxes are covered from the floor to the plates. Each well trap is provided with a scum can made of galvanized iron, wire screened and secured to the frame of the ice tank with a galvanized iron chain.

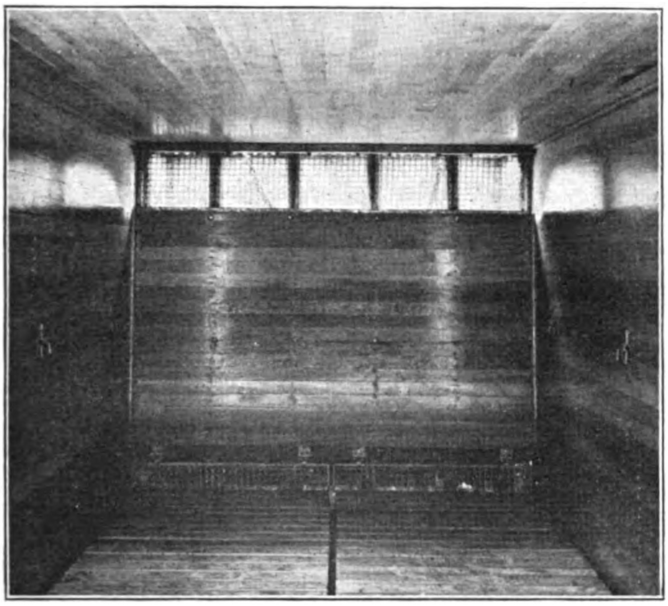
Each bulkhead is lined with Douglas fir, with two courses of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides. One layer of Hydrex weather-proofing felt is applied on each side of the hairfelt and secured with nailing strips. The opening under the bulkheads is provided with swinging protection screens of 1-in. No. 6-gage galvanized wire screen which is properly framed and applied to the bulkhead to prevent the lading from shifting into the ice pans.

The four hatch framings consist of Douglas fir. The

hatch frame covers and plugs are of the U. S. R. A. type, but with the plug detached in order to obtain full opening when required.

Insulation of the roof, side and end walls of the refrigerator cars

A sub-ceiling of ⅜-in. by 3¼-in. Douglas fir is nailed to the 2-in. by 3-in. cross nailers. Over this, the insulation material consists of one course of Hydrex water-proofing felt, on which is then laid two layers of ½-in. Flaxlinum insulation, over which is laid three layers of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides in one piece from side plate to side plate and from the wooden carlines at each ice tank furring. All of the above insulation is held in place at the intermediate steel carlines by bolts passing through the ceiling nailing strips and the bottom flange of the steel carlines. The insulation between the hatches under the carlines and plates is of the same material as specified above and is turned up at the sides and ends and secured to the car by insulation strips.



Equipco all metal pilferage proof bulkhead and ice grates with a special enlarged opening to insure maximum ventilation

The insulating material in the side and end walls consists, first, of one continuous layer of Hydrex weather-proofing felt which covers the main posts and braces from the door post to the corner post and runs from the side sill to the side plate, together with two courses of ½-in. Flaxinum. The next insulating material consists of one continuous layer of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides, which is securely held in place by insulation strips. On these strips is placed one continuous piece of Hydrex water-proofing felt, after which 13/16-in. Douglas fir side sheathing is applied. The end walls are substantially the same except that 2-in. non-void cork is used.

A.R.A. Type "D" couplers with a 6-in. by 8-in. shank with Universal yokes, cast steel draft lugs and Cardwell friction draft gear type G-111-AA are used. The air brake equipment consists of Westinghouse air brake schedule KC-1012, K-2 triple valves, double-spring retainers with Universal booster in the hand brake to give 3,950 lb. at the brake cylinder push rod connection to the cylinder lever. Wine Railway Appliance Company safety first ladders with Viloco step treads were used.

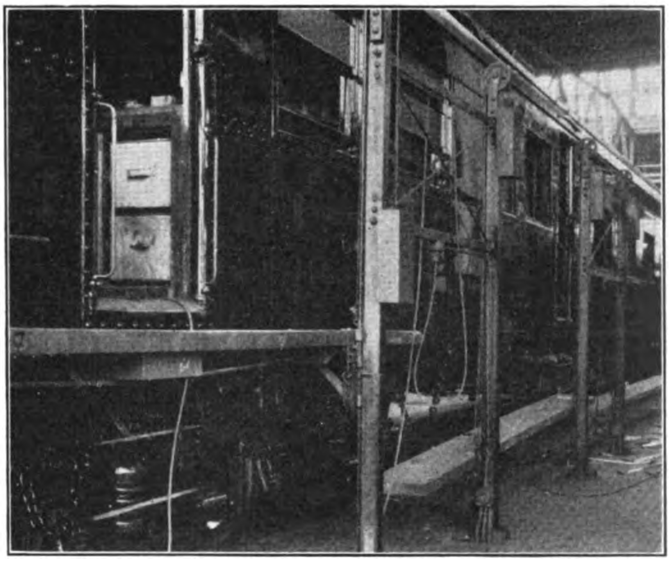
The following are the general dimensions of these cars:

Length over buffers	42 ft. 6 in.
Length over end sheathing	41 ft. 10⅛ in.
Length over end framing	41 ft. 8½ in.
Length inside of lining between ice boxes	33 ft. 11 in.
Width over eaves	9 ft. 5 in.
Width over side sheathing	7 ft. 3¼ in.
Width over side sills	7 ft. 1⅝ in.
Width inside of lining	8 ft. 2¼ in.
Width of door opening	4 ft. 0 in.
Height of door opening	6 ft. 4¼ in.
Height from rail to eaves	12 ft. 2⅝ in.
Height from coil over all	13 ft. 7¼ in.
Height from top of floor to the ceiling	7 ft. 5¼ in.
Cubic feet capacity	1,958

Adjustable scaffolding for car shops

FROM a labor saving standpoint, it is essential that every passenger and car repair shop should be provided with a form of adjustable scaffolding. Such scaffoldings can be generally made in the shop which was the case of the equipment shown in the illustration and used in the passenger car repair shops of the Delaware, Lackawanna & Western at Kingsland, N. J.

The framework of the scaffolding consists of 4-in. I-beams properly spaced to meet existing conditions. The beams are breeched by two parallel angle irons. Holes ½-in. in diameter, 9-in. apart, are drilled the length of the flange facing the repair track. The brackets which hold the boards are fitted over this flange by three clamps which slide along the I-beam. A chain, 12-in. long, at the end of which is attached a pin which fits in the holes, is attached to each bracket. Located at the center of the underside of each board is a box which contains scrap metal, the purpose of which is to counterbalance the board, with the counterbalance supported by a ¼-in. cable which passes over a 6-in. pulley located at the top of each I-beam. Each box is carefully weighted so that the board can readily be raised or lowered by one man. Each box is supported by a ⅝-in. truss rod which passes between the two brackets.



A rigidly constructed scaffolding which can be easily moved by hand to various heights

This scaffolding is cheap to construct, will withstand hard usage and is easy to operate. Furthermore, the frame work can be used to advantage for locating power outlets. It will be noted from the illustration that there is an outlet at the middle of the lower angle iron of each pair of I-beams. These outlets are used for attaching electric lights and motors.

Japanese railways adopt automatic couplers

Final work of changing from the screw and link type to the automatic is completed in one day

By S. Akiyama

Director, Mechanical Engineering Bureau, Japanese Government Railways, Tokyo, Japan

SHORTLY after the nationalization of the Japanese railways in 1906, it was decided that steps should be taken to equip the rolling stock with automatic couplers. At that time, with the exception of the Sapporo division in Hokkaido, which had adopted an automatic coupler of an American type more than 15 years ago, all of the Japanese railways were using the screw and link type. The preparatory work of changing the couplers on all of the rolling stock was begun in 1918 and this work was completed in the spring of 1925. This preparatory work consisted essentially of altering the center and end sills on all old equipment and seeing that the design of all new equipment was such as to permit the application of the automatic coupler and draft gear at the appointed time.

Table I—Number of freight cars and workmen assigned to each coupler changing station

Division	Tokyo	Nagoya	Kobe	Moji: Sanyo District	Moji: Kyushu District	Sendai	Total
Pre-determined allotment of cars	15,000	10,000	10,000	2,500	8,650	6,500	52,650
Pre-determined allotment for July 17 and 20	12,700	8,300	7,849	1,850	7,162	4,800	42,637
Actual number of freight cars on which the couplers were changed on July 20	12,517	8,380	7,607	1,842	7,123	4,213	41,682
Number of workmen employed on July 17 or 20: Repair shops	2,937	2,138	1,507	452	1,492	1,024	9,540
Number of workmen employed on July 17 or 20: Car inspecting points	735	272	698	40	300	354	2,419
Number of workmen employed on July 17 or 20: Total	3,682	2,410	2,205	492	1,792	1,378	11,959
Number of cars per workman	3.45	3.44	3.35	3.76	3.99	3.48	3.56
Number of coupler changing stations	50	54	39	8	45	25	221

The most important factor in the making of this change was to see that traffic went on with as few interruptions as possible. It was decided to perform the work of making the final change of couplers during the month of July. In Japan, the month of July is quite hot and, furthermore, the freight traffic is comparatively light. Many of the freight cars are withdrawn from service, and it was possible to apply the automatic couplers on these cars at any convenient time. The committee in charge of planning the work also took into consideration the fact that the days are quite long in July, so it was finally decided that the final work of changing the couplers should be done on July 17.

July 15 and 16 being Buddhist holidays, it was estimated that the freight traffic would be especially light on July 17. This schedule applied to all districts except the Kyushu district, where the final change was made on July 20. Table I shows the number of locomotives and passenger cars on which the couplers were changed divided according to districts and Table II shows the total number of freight cars and workmen assigned to the various coupler-changing stations.

Planning and organization of the work

All of the plans for the preparatory work were made by the Mechanical Department of the Railway Ministry and the work was performed at the various railway shops. The final change-work was planned by a committee presided over by the vice-minister, but this committee drew up only a general plan. Detailed plans were submitted by a committee nominated by each division office. Each division committee consisted of the chief of the operation section, who served as chairman. Both the chiefs of the mechanical section and the chief of the transportation section served as vice-chairmen and a number of shop managers, car distributing agents, etc., served as engineers and secretaries. Upon the receipt of each detailed plan, it was necessary to decide what factors were common to all divisions and to solve this problem an executive committee was nominated from the committee in the ministry. This committee was presided over by the chief of the operation section and it met with the divisional committees at which time all necessary arrangements were worked out.

The organization of the executive forces for carrying out the work was not identical on all of the divisions. The organization on the Tokyo division, however, is typical. The headquarters of the Tokyo division was located in the division office. On this division ten district headquarters were established, the chief of each being either the district traffic officer or works manager. There were 19 local headquarters under the control of the district headquarters, the chiefs of which were usually the leading engineers of the repair shops. There were 54 working organizations, the chief of each usually being an assistant engineer at a repair shop. There were 50 changing stations. One crew was assigned to each changing station and two crews each were assigned to four of the

Table II—Showing the number of passenger cars and locomotives on which the couplers were changed

Passenger cars changed on July 16 and 17:

	Both ends	One end
Tokyo	90	504
Nagoya	51	353
Kobe	70	432
Moji	25	109
Sendai	40	345

Kyushu district—total passenger cars, 1,046.
Honshu district—total passenger cars, 7,327.

Passenger cars changed on July 19 and 20:

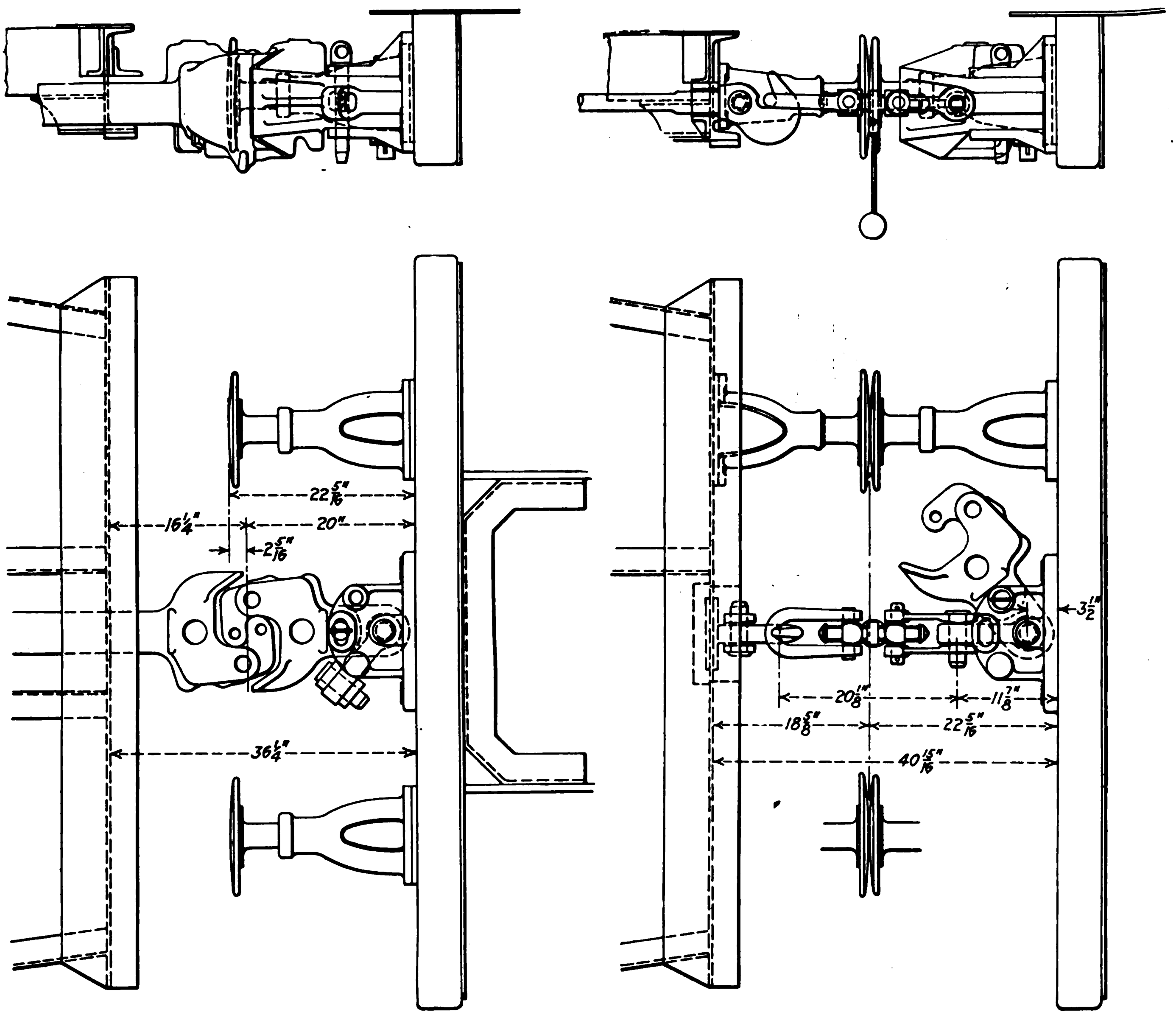
	Both ends	One end
	42	315

All districts—total locomotives, 3,094.

larger changing stations. Each crew was divided into parties in charge of a foreman and each party was divided into gangs, consisting of from five to eight workmen as required. Nineteen gas cutting gangs and 11 relief gangs were distributed among the various local headquarters. There were also 50 "settling" gangs under the jurisdiction of the local headquarters, one of which was assigned to each changing station. A station master was placed in charge of each of these gangs. The function of these gangs was to arrange the cars as required by the working crew, to prepare lodgings and meals, and to dispose of the old couplers, buffers, etc. The "settling" gang consisted of yardmen and employees other than shopmen. This system of organization as outlined, proved to be quite satisfactory.

In planning the details of the organization just described, it was deemed advisable to make several tests. In one of these tests, two skilled workmen changed the couplers of 10 cars in nine working hours. In another test, two workman who had only one or two months' experience as workers in a freight car repair shop and had only practiced changing couplers three times, succeeded in changing the couplers of six cars in nine working hours. After repeated tests at several shops and car inspection points, we came to the conclusion that as a fair average we could counts on about 3½ freight cars per workman, assuming that all classes of workmen employed in the shops were to be used in making the change of couplers.

Workmen of all classes were started about one year ago in a series of training exercises. This work was taken up at all of the shops and car inspection points. It was first done on a rather small scale but as the time for the change approached, the training was performed more intensively so that eventually each workman had at least one day's practice. Some of the workers at the car inspection points were trained to make the change on the freight cars and the remainder were trained to make the change on passenger cars. The work of changing the couplers on the locomotives was performed by the locomotive shop repair men.



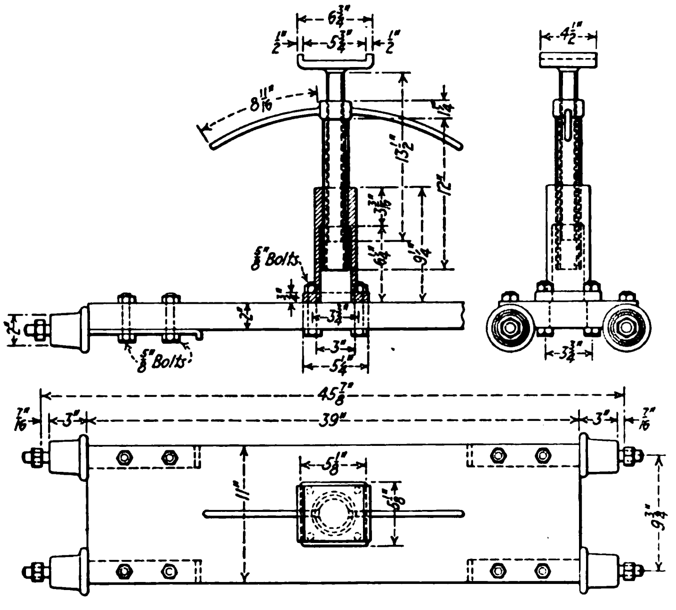
Special coupler designed for switching locomotives handling cars equipped with either automatic or screw and link types

The preparatory work was performed in three stages

The preparatory work was performed in three stages; the first stage consisting of the reconstruction of both ends of the underframe, a portion of the center sills and the attaching of a pair of follower guides to the inside of

the center sills. About one-third of the freight cars were equipped with wooden center sills. These were not strong enough to be used with the automatic coupler and for this reason they were strengthened by means of flat bars, tie rods or angle bars. The center of the end sill was cut to make room for the shank of the automatic coupler, and angle bars were secured above and below to serve as guides for the coupler shank. After the first stage of the preparatory work was completed, the old style drawbar used with the screw and link couplers, was arranged with a special washer to receive the drawbar spring. This reconstruction was performed on all of the passenger and freight cars. The first stage of perparatory work on the tenders was the same as that used on the freight cars.

The second stage of the preparatory work consisted of temporarily hanging the coupler with the draft gear crosswise under the center sills as shown in one of the drawings. The uncoupling lever was also attached. This work was done only on freight cars. There were, however,

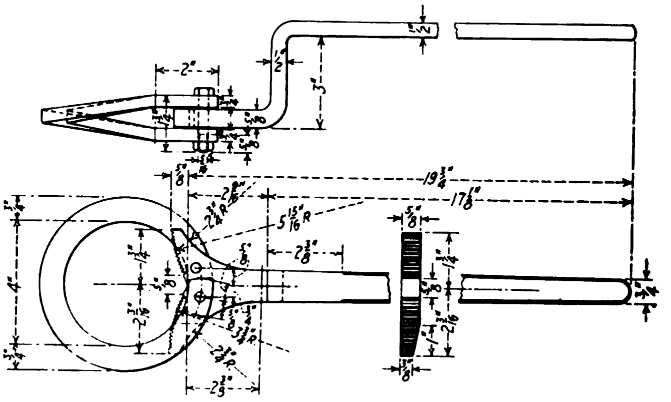


Jack used in the final application of the automatic couplers and draft gears

several kinds of freight cars whose construction did not permit this to be done. Such cars were treated as special cars and other arrangements were made so that the change of couplers could be made on July 17. The couplers were changed on the locomotives and passenger cars as they were brought into the shops for repairs. With this system, the number of locomotives and passenger cars of which the couplers had to be changed at a certain terminal, was known and all the material required was allotted in exact quantities.

The third stage of the preparatory work was the testing of the first stage. It was essential that we knew whether or not the reconstruction of the cars had been properly performed so that the change of couplers could be effected without any trouble. Special gages were provided for making this test. The test consisted of taking the coupler and draft gear which was hung under the center sills and applying them to the underframe as it was to be done on July 17. The uncoupling lever was also examined. The coupler was then taken out and again hung under the center sills. The side buffers were also taken off and attached again. All bolts and nuts were lubricated to prevent their becoming rusty.

This third stage of the preparatory work proved quite



Spanner wrench for unscrewing the nuts of the rigging that held the drawbar to the center sills

effective, not only in discovering defective work, but also in familiarizing the employees with the operations to be performed on July 17.

Special tools and equipment were required to complete the work

The tools and appliances used in completing the third stage of the preparatory work were the same as those used in the regular routine work of changing the couplers. The majority of these tools were not of standard design, being devised by a number of men and, of course, were not uniform throughout all divisions. There were, however, two devices, namely, the jack for the coupler and the spanner for the drawbar nut which were standard. These two devices, which are shown in two of the drawings, were the results of a design obtained by a competition and were extensively used. The jack is a double threaded, double screw jack. The minimum height is 15¾ in., so that it can be placed to receive the coupler which is held under the center sills of the car. The maximum height is 32½ in., which is sufficient to jack the coupler up to its proper position between the draft sills. The spanner, shown in Fig. 3, was designed to unscrew the nuts which held the coupler when hung under the center sills. Both of these tools are of light construction, easy to handle and cheaply made because they were intended for temporary use only.

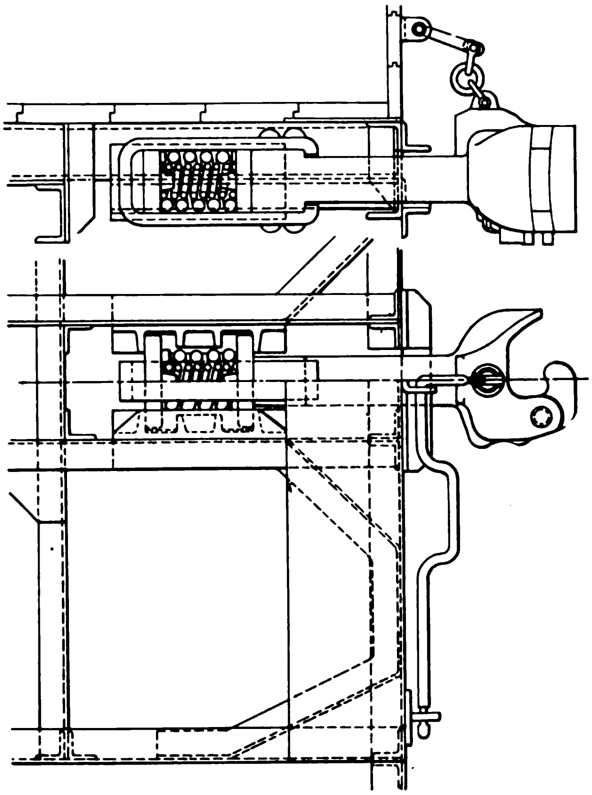
Changing the couplers on the passenger cars

The plans made by the Mechanical Department of the Railway Ministry required that the coupler-change on all

Total expense of changing the couplers

	Locomotives		Passenger cars		Freight cars		
	No.	Expense	No.	Expense	No.	Expense	Total
Preparatory work of first stage	2,529	$328,500	6,385	$1,304,000	41,667	$4,925,000	$6,557,500
Materials, including couplers, their erection	3,344	345,500	9,057	782,300	51,541	4,122,000	5,249,800
Preparatory work of second stage	.....	....	.....	....	......	291,500	291,500
Total cost of changing couplers			.....	....	......	....	$12,098,800

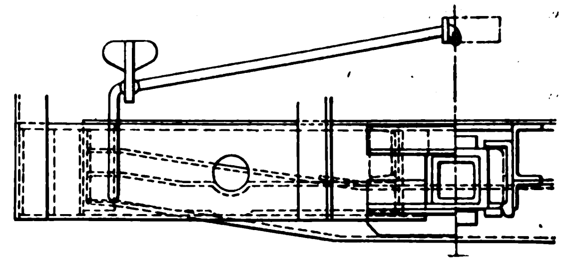
the freight cars be made on July 17 in order to avoid interfering with the movement of traffic as little as possible. The changing of the couplers on the passenger cars, however, could not be done at one time because the cars mak-



Drawing showing the design of draft gear the Japanese Government Railways are using in connection with the automobile coupler

ing up a train were usually treated as one set and were seldom used in other trains. Thus, the couplers on the passenger cars which composed a regular train were changed in the period between July 1 and July 10, except the couplers on either end of the train. The couplers on spare cars and those undergoing repairs were changed during the period between July 11 and July 16. The couplers on either end of the train and the locomotive couplers were changed on July 16 and 17. This arrangement was carried out in all districts except in the Kyushu district where these couplers were changed on July 19 and 20.

The changing of the couplers on the end cars of the train and the locomotive, was done according to a predetermined schedule arranged to conform to the short time that the locomotive and train were to stay in the terminal,



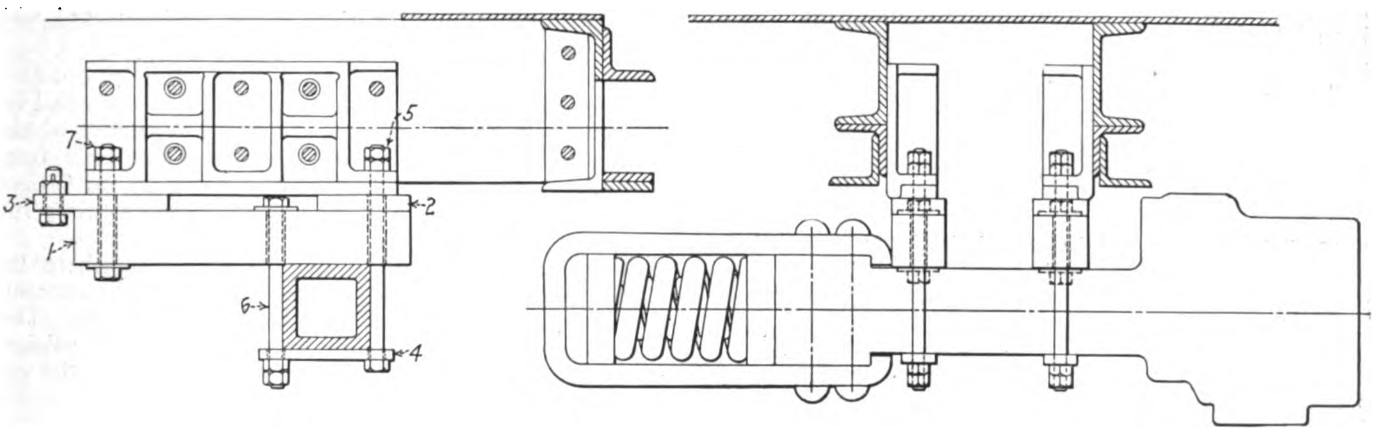
between trips. With this arrangement, the passenger service on July 16 and 17 was maintained with its usual regularity. It was necessary to provide a switching locomotive with a special coupling to handle cars equipped with either type of coupler.

Freight train service was suspended for one day

Freight train service was suspended for one entire day; namely, from midnight to midnight, except for certain special freight trains used for the transportation of fish, etc. In some districts the number of delayed trains was comparatively large, and at points where the station yards were comparatively large, it was found that the changework could be performed by suspending only a few freight trains. It would have been poor practice to have adopted such a system on the main lines because a delay in any station would have caused confusion on the whole system and even the passenger service might have become seriously affected. For this reason, after the suspension of the regular freight trains, all of the freight cars were collected at the larger stations selected for changing couplers during the night.

There were a total of 221 such stations and as fast as the cars arrived at the changing stations they were arranged at regular intervals of about 40 ft., buffer to buffer.

The plans required that the cars be arranged by 5 a. m. and the work of changing commenced at that time and finished by 7 p. m. It so happened that the work was started at some stations as early as 4 a. m., part of the work being done on the previous day. All of the changeover work on the Sendai division was completed before noon. The work was finished on the Kobe division at 4:30 p. m., on the Tokyo division at 5:30 p. m., on the



Drawing showing how the automatic couplers and draft gears were temporarily hung under each car so that they could be easily applied on the day set for completion of the work

Moji division (Sanyo district) at 6:30 p. m., and on the Nagoya at 8:00 p. m.

The privately owned railroads, whose freight cars are operated over the lines of the Government Railways, also changed their couplers at the same time and in the same way. The Government Railways paid about $126 per car as a subsidy.

One of the most important factors of the change-over work was the final inspection. In order that the work of inspection be carried on efficiently, the foremen in the repair shops were previously instructed and these men served as inspectors as well as supervisors of the work.

The old couplers and buffers were loaded into empty cars as fast as they were removed and were not allowed to litter up the yard so as to hinder the progress of the work. They were later sent to various shops to be handled as scrap.

It was feared that many of the workmen might be injured during the work of changing from the old style to the new coupler, because there were many who were not accustomed to such work. The result, however, was satisfactory. There were, of course, a few men injured, but all of these injuries were slight.

Sharon and Alliance type couplers adopted as provisional standard

The Japanese Government Railways before finally deciding on what type of automatic coupler to use, gave serious consideration to the automatic types used in both Europe and America. The A. R. A. standard type "D" coupler was considered too heavy for the rolling stock used on the Japanese railways and it was finally decided to adopt the Sharon type coupler which had given satisfactory service on the Sapporo division. The Alliance coupler was afterward introduced and has proven to be equally as good. These two types of couplers are purchased from America and have been adopted as the provisional standard. They are used on practically all of the rolling stock in Japan. The draft gear is of simple design, consisting of front and rear followers and a coupler yoke to hold the draft gear in position as shown in one of the drawings. This type is considered good enough for the present traffic conditions in Japan, but it will doubtless be necessary to improve the draft gear sooner or later. A new coupler of Japanese design has recently been introduced and it is expected that this type will be extensively used.

As the matter now stands, the coupler problem on the Japanese railways has been solved. The most important parts of the Japanese railways are now under one control and, furthermore, there is no through traffic beyond the Island of Japan. This situation influenced to a large extent the decision to adopt the automatic coupler which was a fairly large undertaking.

Table III—Number of injuries and deaths in 1922 and 1923 incurred while coupling cars

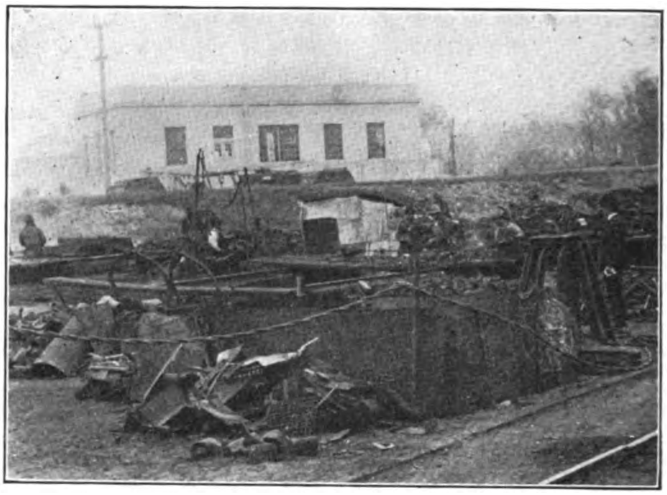
Division	Type of coupler	Switching incl. coupling work 1922	Switching incl. coupling work 1923	Coupling work only 1922	Coupling work only 1923
Tokyo	Screw and link	158	177	69	74
Nagoya	Screw and link	116	97	61	30
Kobe	Screw and link	117	134	23	26
Moji	Screw and link	85	114	33	49
Sendai	Screw and link	83	77	41	25
		559	599	227	204
Sapporo	Automatic	41	27	6	0
		600	626	233	204

This improvement of couplers will undoubtedly aid in the development of traffic and should also provide safer working conditions for the railway employees. It was always a dangerous task to couple cars equipped with the screw and link type coupler, especially in Japan, because the difference between the buffer and the coupler was only 2 ft. from center to center. This is especially emphasized in Table III, which gives the vital statistics showing the number of injuries and deaths in 1922 and 1923 occurring in switching and coupling work.

Protection for acetylene torch outlets

By Charles W. Geiger

At the reclamation plant of the Southern Pacific, Sacramento, Cal., there are nine cutting torch outlets for supplying acetylene gas. The gas is manufactured in a central plant and is piped to all parts of the yard. As shown to the left in the illustration, these outlets are protected by four steel rails bent into the form of a pyramid. This arrangement protects the outlets from being broken or bent by heavy material striking them as it is being handled about the yard. If the operator is using a torch at some distance from the outlet, the hose is carried on metal stands like that shown in the foreground of the illustration. This method of supporting the hose from the ground, protects the hose from being cut or broken by heavy castings falling on it or by trucks being run over it.



View showing reclamation plant of car yard equipped with protective device for acetylene outlet

Three mains lead from the central plant where the acetylene gas is manufactured to the various departments of the general repair shops located at Sacramento. This system of providing gas has proven to be quite efficient in assisting in the performance of the work of the car shop and scrap dock.

The "Broadway Limited" and the "American" trains, of the Pennsylvania are to be completely re-equipped with new cars. The Pullman Company is turning out 60 cars for this purpose on rush orders. The new cars will offer many original and novel features of design, including a women's lounge and shower bath and a private office for business men. Interior decoration of a new type will provide a restful atmosphere of soft color harmonies. Of the new cars, 32 will be used on the "Broadway," the 20-hour train between New York and Chicago and 28 on the "American," the 24-hour train between New York and St. Louis.

Utilization of freight cars*

Considered from the viewpoint of loading design and maintenance

By L. K. Sillcox

General Superintendent of Motive Power, C. M. & St. P.

DATA now furnished show the miles per day per locomotive and per freight car. The manner in which the information is compiled is sufficiently divided to enable it to be worked into several factors. We have attempted to gage the performance on the basis of miles per day per locomotive or freight car on line and as a result we have what may be termed a statement of the performance in relation to equipment at hand, rather than a statement of performance of the units actually in service, excluding those stored serviceable or awaiting repairs, etc. In the case of freight cars, it would be necessary to know each day the number out of service for repairs as now shown on the usual form of bad order reports, the number stored serviceable and the number in actual service. When divided in this manner, it is then possible to analyze the performance by hours per day to indicate the dead time encountered in train movements, because this lost motion affects the utilization of cars on the one hand and it is further aggravated by improper facilities respecting sidings, yards, terminals, etc. On the other hand, if we attain the greatest possible net ton mileage with the least actual number of freight cars and freight car miles, then we have a measure of performance which is of benefit to those administering car distribution or those who may largely control their utilzation. If we know that we are handling a certain tonnage with fewer cars today than heretofore, then we should know by what means this is accomplished, so that proper elements may be set up for further improvement.

The primary requisite for a high degree of utilization of freight cars is a condition of favorable road characteristics which permit trains to move without interruption between terminals at a uniform speed. The average speed is now about 12 miles per hour for freight trains, meaning that the distance run between terminals is consumed on this basis, but that at certain intervals a much greater speed is attained in order to maintain this average. The limitations placed upon freight car utilization are, for the most part, not due so much to the character of the equipment as to the obstructions in yard, terminal and road handling.

The amount of freight equipment in the country today is the result of a variety of policies. It is presumed that the administrative methods employed were merely influenced by periods of car shortages and surpluses. This is not so great an element in the question of proper ownership today because there is an ever increasing efficiency in the matter of car distribution throughout the country as a whole. The result is that the car shortages are decreasing and car surpluses are increasing, even in the face of more traffic to be handled. Therefore, the improvement in methods of distribution makes it unnecessary to increase the total number of cars available for service, but rather to replace worn out cars with new units of greater capacity and availability. The increase in the average capacity of freight cars has been 60 per cent since 1902 or from 28.1 tons to 44.5 tons. If we are to attain greater utilization of cars, the increase in capacity will permit this and, at the same time, will require relatively fewer individual units for the service.

We have before us, in this discussion, the question of the general performance of equipment as a whole throughout the country. If the art of design and construction were to develop uniformly, the equipment would reach the obsolescent state at the same time and the problem of overcoming obsolescence by retirements rather than improvements would be greatly simplified. In the past ten years, however, the practice has been to overcome partial obsolescence by improvements, so that the life cycle is indefinite and the character of equipment as to design and construction is not uniform. In this way, there is not as rapid an increase in the average capacity of freight cars as would otherwise be the case. The obsolescence referred is more in the nature of design than resulting from deferred maintenance.

Beyond this we have the problem of the distribution by types. Some carriers have a large majority of open top cars while others may require a large number of house cars. The question of ownership is usually affected by the prevailing character of the commodities handled. Loading in general, or by commodities in particular, is not uniform throughout the year, so that carriers are confronted with high and low peak seasons. If the traffic on each line were confined to cars owned by that line, this would require an ownership capable of taking care of the peak load, so that there would be no shortage throughout a large portion of that time. On the other hand, the interchange of cars is such that ownership for peak loading is not always required and it is this particular feature of car ownership from which results a greater flexibility.

Comparisons based on the amount of investment in freight cars in relation to the performance as to net tons, miles per unit, or some other such factor, are quite often prepared. Much as in the cases of utilization of power, wherein must be considered the relation of miles per day

Comparison based on units and capacity of freight cars, showing the saving effected by large capacity cars

Nominal Capacity	50 ton	40 ton	30 ton
Limit load on rail in lbs.	169,000	136,000	103,000
Average light weight in lb.	46,000	42,000	36,000
Load carrying capacity in lbs.	123,000	94,000	67,000
Total tons load carrying capacity required	2,400,000	2,400,000	2,400,000
Number of cars involved	39,025	51,064	71,642
Average investment cost per lb. of lt. wght.	3⅓c.	3⅓c.	3⅓c.
Value per car	$1,532	$1,399	$1,199
Total investment	59,786,300	71,438,536	85,898,758
Interest at 6 percent	3,587,178	4,286,312	5,153,925
Net interest saving	1,566,747	867,613	
Maint. cost at 12 per cent of invst. cost	7,174,356	8,572,624	10,307,850
Average per car per year	184	168	144
Saving in maintenance	$3,133,449	1,735,226	
Depreciation, interest, taxes, etc. at 2½%	1,494,658	1,785,963	2,147,469
Savings in depreciation, interest and taxes	652,811	361,506	
Summary of savings	$1,566,747	$ 867,613	
	3,133,449	1,735,226	
	652,811	361,506	
	$5,353,052	$2,964,345	

*Abstract of paper presented before the Railway Club of Pittsburgh, September 24, 1925.

per locomotive owned and miles per day per locomotive used, we also have to consider some such feature as regards freight cars. However, mileage is so low in freight car performance that to present a factor of relationship of miles per car in service as compared with miles per car on line would not be of any particular moment. We can consider a rather definite factor in the table showing a comparison based on units and capacity of freight cars, thus representing the relation of the carrying capacity requirement, the number of units, the capacity per unit, the investment cost, and the maintenance.

In this illustration it is assumed that the carrying requirements was 2,400,000 tons and that this would be provided either by 30- 40- or 50-ton units. Of course, with larger units it is necessary to provide a smaller number than in the case of smaller units. The average weight per car of different capacities is merely a rough estimate representing all classes of freight cars. This also applies to the average cost per pound and per car, which may be higher for certain classes of cars and possibly lower for other classes of cars. Whether the estimated costs are high or low in this case does not affect the final results materially, nor does it affect the stated savings, because these factors change the results to but a small degree.

In this statement the maintenance is estimated at 12 per cent of the cost of the car per year. The depreciation, insurance and taxes are stated here at the rate of 2½ per cent of the investment. In this respect there is no uniformity of practice, some carriers using one per cent or less for depreciation alone while others employ from four to five per cent. If the case of any carrier could be stated definitely in this form, it would indicate that in the order of importance the possible savings would be in maintenance due to heavier and better cars, representing about 60 per cent of the savings, the reduction in interest amounting to about 28 per cent of the savings, and about 12 per cent representing a possible saving in depreciation, insurance, taxes, etc.

Therefore, there is involved in this question not only the number of cars to be operated, but the average capacity. In order to attain greater utilization of equipment, it would be possible, in theory, to reduce the number of car miles per day, per month or per year and increase the net ton miles with the larger car, provided the movement of commodities permitted of full loading and reduced the proportion of l.c.l. loading. The net tons per train have increased, in the past 20 years, far more rapidly than the cars per train. This movement has been gradual. We may expect that commodities will be moved in such a manner as to permit increasing the average load per car, and with this movement the tendency towards providing larger and heavier cars is continued. In the past few years the average tons per car did not increase at the same rate as the average capacity per car. It should be understood that since the increase in the size of trains, the gross tons per train, etc., with the advent of larger power, it has been necessary to strengthen freight cars. It is, therefore, inconsistent to employ a mandatory strength requirement if the capacity is not increased accordingly, because it is not economical to provide strength of members and fail to have capacity comply therewith. In the past 20 years freight cars have increased in capacity, and consequently, in relative strength, about 60 per cent, whereas, during the same period average locomotive tractive force increased 100 per cent, thus illustrating the great need of building up car members to meet such conditions. The average weight per car did not increase in the same proportion as the capacity.

Under present methods of recording miles per day per freight car it would appear that, considering a bad order situation of eight per cent and an average mileage per car per day on line of 27, by deducting the eight per cent we have an average mileage per serviceable car of 29 per day. Then assuming that the average speed of freight trains is 12 miles per hour and the distance run is 29 miles per serviceable car per day, this would result in an actual period of 2.42 hours in train service out of every 24 hours. This would leave 21.58 hours per day consumed in loading, unloading, switching and other time of an apparently unproductive nature. The above is based upon the action of serviceable cars, but although not representing the actual condition, is merely offered as an illustration. If this were confined to cars actually in trains, it would result in more than 2.42 hours per movement or per day. Nevertheless, we are seriously confronted with the duty of attaining more miles per serviceable car and for that matter obtaining more miles for total cars.

The mechanical department is concerned in this performance in that more cars should be made available for service. It is economical to have a high degree of maintenance or a good condition of equipment. This is illustrated by the following:

All class railroads—Period of four years—1920-21, 22 and 23 (Based on I. C. C. reports.)

Carriers having per cent of bad order freight cars. From	To	Ave. cost per car per year for repairs.
0	5	$151
5	10	179
10	15	186
15		187

The records show that the better equipment is maintained, the less it will cost to keep in condition.

If the bad order situation is reduced but the hours of service per car are not increased, then there is a lack of proper utilization. We have periods of surplus and periods of shortage and it would seem that the policy recommended for locomotives could well be followed for freight cars in that when loading is low, cars can be set aside so that as few as possible will be in actual service. It is recommended that the utilization of cars be interpreted to mean that the greatest amount of tonnage and mileage be attained with the least possible number of units.

The employment of freight cars, when based on net ton miles, can improve most effectively where the increase in the average capacity of cars and their assignment to the fullest possible loading is fully applied. The miles per run per load is also a factor in this measure of performance.

Cars are now loaded to approximately 60 per cent of their capacity, but this factor cannot be considered as improper utilization since greater volume, in relation to weight, is experienced with certain classes of loading. Automobile and furniture loading will illustrate this point. The loaded car miles per loaded car per day is a measure well worth considering in attempting to increase the service of freight cars.

The per cent of loaded to total car miles is a very important feature in proper utilization in that, if the loaded percentage is small, the elements which build up revenues are not favorable. If the net ton miles per loaded car are high, but the percentage of loaded to total car mileage is low, then we still have a situation which is not favorable to intensive utilization. If the loaded movement is all one way, this also affects performance.

Loading

The loading characteristics throughout the country indicate the heaviest tonnage to be in products of the mines. Then in order come manufacture, agricultural, forest, and animal products. The number of car loads handled

in 1924, together with the average load per loaded car, was as follows:

Classification of car loads handled in 1924

Products	Loaded Cars handled	Average Load Per car, tons
Mine	12,794,674	48.5
Manufacturing	9,921,986	23.8
Agricultural	4,758,344	21.8
Forest	3,780,341	24.6
Animal	2,356,574	12.8
Total	33,611,919	34.0

The product of mines not only represent the greatest amount of tonnage handled but permits of a heavy loading per car. This amounted to an average of 48.5 tons. Here we are permitted to load cars to full capacity with the possibility of decreasing car movement and mileage by having cars of greater capacity or of a convertible type. One line in the east has gone to the large dimensioned car very extensively and have some with a capacity of 120 tons. It is in this sèction of the country where the average load per car ranges between 55 and 60 tons. The heaviest average tonnage per loaded car comes from iron ore mines. This amounted to an average of 53.5 tons, with a range between 63.1 on one road to 43.1 on another, depending on the size of equipment offered by the various carriers for such loading. Bituminous coal offers the next highest average loading or 51.7 tons with a range from 72.0 to 26.2 tons. The spread is rather radical, but is due to the greater distribution of coal fields and a greater variety of equipment offered for loading. Bituminous coal loading constitutes approximately one-half of the total products of mines. Practically all of the products of mines require open top cars.

Manufactured articles occupy the second place in the total movement of car loads, but represent a very low average tonnage, this being 23.8. This is due to the character of the commodities in this group, most of which have a high displacement or require more space per pound of weight than products of mines. The greatest average loading in this group was represented by pig iron or 40.9 tons per car. Cement resulted in 38.0 tons per car. Most of the manufactured articles require house cars. Automobiles offer the least tonnage per car, this average being 8.2.

Agricultural products called for 4,758,344 loads, but gave an average of only 21.8 tons. The load is higher than the average in the Northwest region for the reason that wheat offers the heaviest tonnage in this group, or 40.8. Cotton is responsible for the lightest tonnage or 11.3. Products of agriculture require mostly house cars.

The products of forests offer only 28.1 tons per car, the heaviest being logs and the lightest miscellaneous lumber. This movement requires flat, gondola and house cars.

Products of animals offer a low loading, especially for live stock. Leathers and packing house products offer the heaviest loading, but the average for all is only 11.8 tons.

Design

Until recently the question of design and interchangeability of parts, while covered in a general way in the A. R. A. manual, was not extended to various members in the body. Standard designs are being fully worked out with a view to attaining the greatest possible strength and capacity with the least possible weight. The tendency is to increase the capacity of the cars, which places upon all concerned the duty of increasing the performance of each car required for loading. The tare weight is a feature of design which has been given much consideration. The tare weight of low capacity cars is greater than high capacity cars when measured by tons capacity. This is shown in the following statement in a very general way:

Nominal tons capacity	Tons av. weight loaded	Tons av. tare weight	Per cent of tare to total	Per cent of carrying capacity total weight
30	48	18	37.5	62.5
40	61	21	34.4	65.6
50	73	23	31.5	68.5

These figures represent stenciled capacity and make no allowance for permissible axle loads. From this it may be stated that the percentage of dead weight decreases with the increase in capacity, or in other words the non-productive weight does not increase in proportion with the capacity. This is another argument, especially when actual allowable axle loads are considered, for larger but fewer cars to handle the traffic wherever loading will permit.

The rolling friction increases as the number of bearing surfaces increase. The following shows how this is worked out:

Variation in resistance in relation to variation in light weight of freight cars

Tons light weight per car	Per cent increase	Pounds of resistance per ton weight of car	Total resistance for light weight of car in lb.	Per Cent increase
20		7.00	140.00	
25	25.00	5.89	142.25	1.4
30	50.00	5.13	153.90	9.0
40	100.00	4.20	168.00	20.0
50	150.00	3.64	182.00	30.0
60	200.00	3.27	192.20	40.0
70	250.00	3.00	210.00	50.0

The proportionate increase in resistance is about one-fifth the proportionate increase in weight. Wind friction is reduced with fewer and larger cars per train.

Design is mostly concerned, however, with strength of materials and with the arrangement of parts. The objective should be to provide a unit which will run, as a whole, from one heavy repair to another with a minimum of intermediate attention. The question of larger cars is also involved. Where there are fewer larger cars constituting a train, the length is less for the tonnage carried. This also simplifies the making up and breaking up of trains as there are fewer cars to handle.

Maintenance

It is usual to judge maintenance by the bad order car situation. If we were in a position where a constant car shortage existed, then the question of the number of days cars are detained for this purpose would be of extremely great importance.

There is now developing a greater tendency towards making classified repairs to freight cars on somewhat the same principle as applies to locomotives. The latest development along this line is to provide facilities and forces so as to run a greater number of cars of the same type and design through shops in a short period of time doing practically the same amount of work on each car. Where this work is heavy enough, it should finally result in a service cycle between classified repairs of approximately eight years. This should be done with a view to reducing intermediate light and running repairs in the meantime. In the long run this will result in providing more service days per car. The development of lay-outs and spacing of car repair terminals has not always been according to a specific plan. For this reason, much remains to be done in the matter of location and type of facilities for freight car repairs. A system having 80,000 cars and an average cycle of eight years between heavy repairs would have to run 10,000 cars through the shops each year provided the repairs came due in order. With facilities adapted to such a plan, it might be found that the number of light and running repair points could possibly be reduced, especially if a plan could be worked out

to have greater distances between train classification terminals, where facilities are constantly employed.

While we are wrestling with causes, methods, fundamentals and ultimates, it would be well if we could rearrange our thinking on a factor which exerts a primary as well as a more direct influence than any other feature on the efficiency with which shop operations are handled, namely, that of employing a minimum steady satisfied force, also a minimum number of thoroughly modernized plants and having car maintenance work handled in an orderly fashion throughout the year rather than to follow seasonal demands. If we are to effect the greatest return from a minimum force of men, the least outlay for fixed facilities, and the smallest number of cars to handle a given volume of business, such a plan should receive careful thought. This necessitates the preparation of a budget in which the funds available are allotted to those projects which it is considered most important to carry on. When this budget is approved and the amount of work to be done fixed, it is then necessary to prepare a program or schedule so that the projects may be carried out to the best advantage. It is highly essential that the budget be approved and the program completed sufficiently in advance to enable the materials to be assembled and the forces to be organized to do the work in a logical fashion.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car damaged due to ice in brake dog

On January 4, 1924, car No. 2935 owned by the Union Refrigerator Transit Company was damaged in switching service on the lines of the Belt Railway Company of Chicago. On January 9, a copy of the hump rider's damage report, together with a list of defects on the car and the estimated cost of repairs was forwarded to the car owner. The handling line requested that the car owner furnish disposition of the car in accordance with Rule 120. The handling line's report stated that Swift Tank Line car, No. 5996 was switched over the hump and struck the Union Refrigerator Transit Company's car No. 2935 owing to the fact that the rider could not control the car as the hand brake was inoperative, due to the brake dog being clogged with ice. The handling line stated further that it reported the case under A. R. A. Rule 120 and that it complied with all the requirements and conventions of Rules 43 and 120 and as it was not subjected to any of the unfair usage conditions mentioned in Rule 32, the damage was the owner's responsibility. The car owner accepted the statement that the car should have been reported under Rule 120 and accepted its inspection reports as correct showing the nature and extent of damage to the car and also accepted the hump rider's accident report which indicated the circumstances under which the failure occurred but failed to agree as to whether, under the A. R. A. Rules, the handling line or car owner was responsible under the circumstances. The car owner further stated that the failure of U. R. T. car No. 2935 was due entirely to the lack of ordinary care on the part of the handling line and, therefore, should be the handling line's responsibility.

In rendering its decision, the Arbitration Committee stated that, "As the damage occurred due to inoperative hand brake which should have been detected by the handling line prior to dropping the car over the hump, the handling line is responsible."—*Case No.* 1343, *The Belt Railway Company of Chicago vs. Union Refrigerator Transit Company.*

Responsibility for car uncoupled by trespasser

A Belt Railway of Chicago locomotive handling a train of 82 cars was travelling northbound when some one climbed through the train, stepping on the pinlifter of St. Louis-San Francisco car No. 37239, and disconnecting the train. When the slack ran out, the air hose parted, causing the air to set, with the result that the coupler and draft rigging was pulled out of St. L. & S. F. car No. 1261. The handling line contended that the car was damaged in fair service and was not the result of the air being set from the rear end, as intended by the last sentence of Interpretation 5 of Rule 32. The owner stated that it was understood that if a train parted by reason of defective equipment, the car owner will be held responsible but that it does not seem reasonable that a car owner should be held liable for the acts of trespassers, as in this particular case.

The Arbitration Committee rendered the following decision, "Damage occurring under such conditions is not unfair usage as defined by Rule 32. Car owner is responsible."—*Case No.* 1340, *The Belt Railway Company of Chicago vs. St. Louis-San Francisco.*

Responsibility for wrong coupler repairs

According to the repair card dated May 2, 1921, the Louisville & Nashville at its Corbin, Ky., shop, applied to the A end of Atchison, Topeka & Santa Fe car No. 49384, a new 5-in. by 5-in. by 6½-in. coupler and a 1¼-in. by 5-in. by 84 in. coupler pocket. When this car reached its home shop a joint evidence card was secured which showed that at the A end of the car, one coupler 5 in. by 5 in. by 9⅛ in. and one sleeve 1¼ in. by 4½ in. by 9⅛ in. by 32½ in. with plain ends were applied instead of a 5-in. by 5-in. by 6½-in. coupler and a 1¼-in. by 5-in. by 8½-in. by 32½-in. sleeve with reinforced ends, which are standard to the car. The wrong repairs were corrected and the joint evidence, together with the billing repair card was presented to the L. & N. with a request for a defect card. The L. & N. furnished a defect card for the material covering the wrong coupler but refused to allow material for the wrong yoke claiming that the yoke is not an A. R. A. standard, and that under Rule 88 it was responsible for the labor only of correcting the wrong repairs and that this is covered by the coupler operation. The car owner contended that under Rule 17, the repairing line is also responsible for the material to correct the repairs caused by the application of an improper yoke as it was neither A. R. A. standard material nor standard to the car. The car owner also contended that it was a well defined principle of the A. R. A. Rules that the owner's standards must be maintained unless the repairs are made by the substitution of A. R. A. standard material.

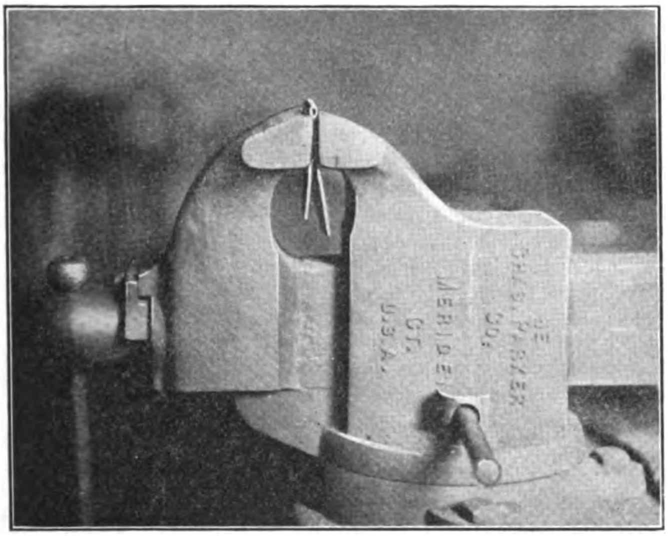
In rendering its decision, the Arbitration Committee stated that, "The contention of the Atchison, Topeka & Santa Fe is sustained. The Louisville & Nashville should issue a defect card to cover labor and material for correcting the wrong repairs made by it.—*Case No.* 1345, *Atchison, Topeka & Santa Fe vs. Louisville & Nashville.*

Shop and employment tests for qualified welders*

By Glenn O. Carter

Consulting engineer, The Linde Air Products Co., New York

SUCCESSFUL welding is built on the basis of qualified welders. This is irrespective of the process, be it oxy-acetylene, electric or hammer. The fact that an operator has proved his ability to make a good weld is by no means a complete assurance that he will never make a poor weld. But a proper test for qualification will make sure that the welder is capable of depositing metal of the strength desired and then if subsequent tests show that workmanship is poor, there can be a definite placing of the responsibility on the welder for failure to do his best. Experience has indicated that welders maintain a high average standard in their daily work.



A good weld will not fail even when bent double

Qualification tests should be made using almost identically the same materials that the welder will work with. This is of prime importance as welding conditions vary where there are considerable differences in the thickness of the base metal, the composition of the metal and the composition of the welding rod. This is of such importance, that where a man, known to be a good welder on certain materials, is considered for welding on important work with some other material, he should make a qualification test to insure good workmanship. For instance a man who is a good welder on 1½-in. steel plate may be, and probably is, a good welder on heavy cast iron, but it is obvious that the work is of such a different nature that the good steel welder might not be good on cast iron.

The conditions in welding light material of, say, from 20 gage up to 10 gage vary so from welding on ½-in. plate that a check test should certainly be made before a welder accustomed to either weight of steel starts on the other.

How qualification tests should be made

The question now arises as to what is a satisfactory qualification test. In my opinion, a welder should be called on to make a short test weld of from 3 in. to 6 in. or more and this test piece should be cut into strips from 1½ in. to 2 in. wide and the strips tested by bending in a vise or over an anvil. This simple test is effective for judging the ability of a welder. It is, however, one that depends on the judgment of the supervisor and can only be evaluated with difficulty. It shows the soundness of the deposited metal and the amount of penetration.

In most cases, when welding on average materials, the management would not need to carry a test any further, but if a welder is to work on important welding where the joint is to withstand severe loads, an additional test is decidedly advisable. This may involve a real expense for testing, but when the test has been made and results reported, everyone from the engineer who supervises the welding to the management of the welding shop and the welder will be glad to have the information.

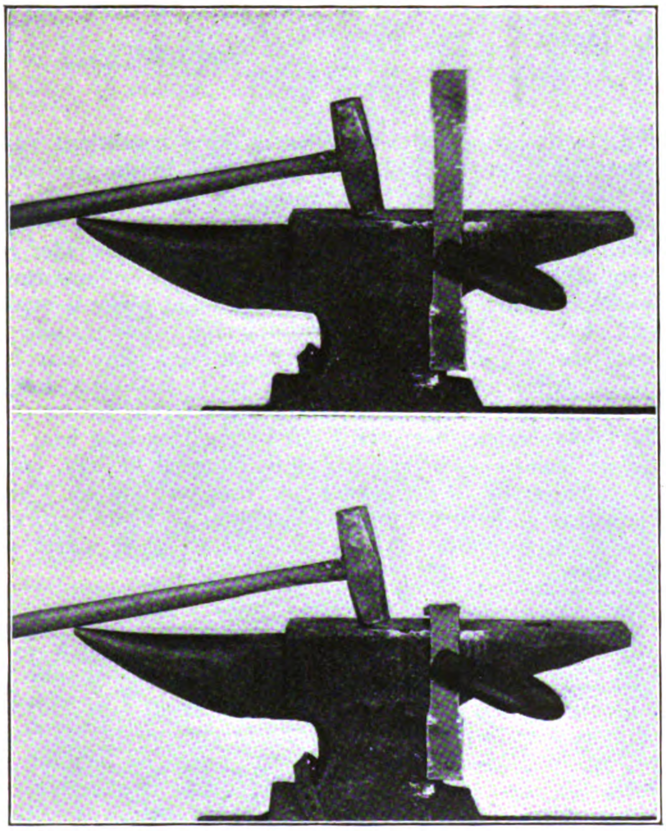
In many cases, applicants for welding work are good

*Abstract of the paper presented before the Metropolitan Section of the American Welding Society, November 13, 1925.

welders with other apparatus than that to be used for the welding considered. Therefore, if a qualifying operator asks to use equipment with which he claims to be familiar or with a different welding head and pressure than is specified for the job, it will be well to let the applicant prove his ability by furnishing him with the desired apparatus. If a man is a good welder with one type of apparatus, it would justify spending a few hours or a couple of days to let him learn how to handle other equipment. The final test should, however, be made with the equipment, the material and under the conditions of the actual work.

For an exact test, it is desirable to have the test pieces made up of material of almost the same thickness and quality as the finished work. It is also advisable to have the test pieces of such size that they can be compared with other test results both in welding and in standard materials.

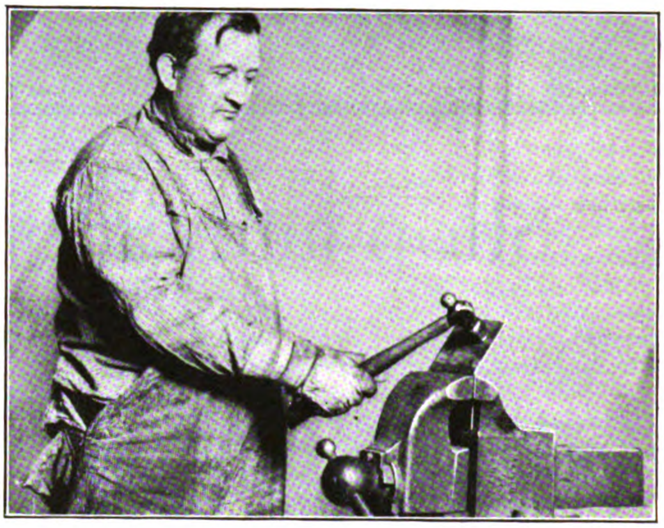
On this account in plate metal work, test pieces should be 9 in. by 12 in. and if they are to be beveled, the beveling should be along a 12-in. edge. When the weld has been made joining two 12-in. edges, the plate will then be 18 in. long and 12 in. wide. If the plate is of steel, the test pieces can then be roughed out with a cutting torch so as to obtain strips for machining or grinding out five standard A. S. T. M. flat test pieces. If the material is other than iron or steel, the plate will have to be cut up into strips on a machine tool.


Proper method of clamping a test weld to an anvil—Note that the piece did not break at the weld

After the plate is cut into strips, each test piece is then machined out at its central part so that the standard 8-in. test can be marked off over a section which will be 1½-in. wide. There will be some excess metal at the grip as is the regular practice. In cutting the strips from which the test pieces are to be made, it is good practice to cut ½ in. off each end of the weld so that the testing of the workmanship will not be complicated by the starting or the finishing of the welding operation. A properly marked off plate is shown in one of the illustrations.

These test pieces will then be pulled in a tensile test machine and the test reports should show the elastic limit or yield point; the ultimate strength; elongation, both in 2 in. and 8 in. and reduction of area. The report should also indicate the nature of the fracture and if a failure has occurred in the weld, what percentage of the area was not welded on account of the lack of penetration or blow holes.

In some cases the welds are ground flush with the plate, but it is now common practice to leave the welded zone unground on the flat surfaces as that is the way the weld will be in the finished article. The thickness of the material should be noted as well as the average cross section of the weld zone. If the failure occurs in the weld, the strength of the deposited metal should be calculated both from the cross section area of the zone of fracture and on the basis of the cross section of the plate. If, however, the failure occurs outside of the weld zone, the strength of a test piece should be calculated only on the cross section of the base metal.


When testing a weld in a vise, bend it so the top of the weld will be stretched

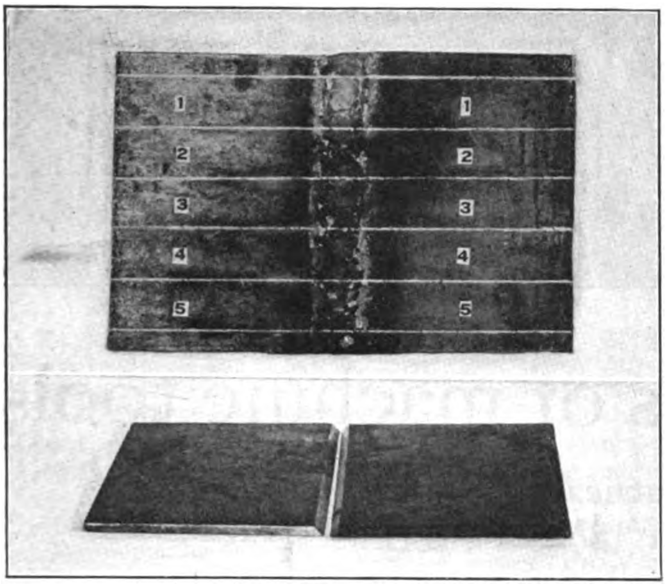
With different grades of deposited metal, different standards should be looked for. In oxy-acetylene welding with Norway iron, which is so low in carbon as to have a maximum strength of about 52,000 to 55,000 lb. per sq. in., a welder should develop a strength of weld through the weld zone of 40,000 lb. per sq. in. for a single vee weld and 45,000 lb. per sq. in. for double vee. With Norway iron, the failure will nearly always occur in the weld, because almost any steel plate is stronger than 45,000 lb. per sq. in.

When welding with nickel steel filler of good quality or with high test welding rod, the failure should occur in the base metal of average steel as frequently as in the weld zone. A qualified operator should develop at least 50,000 lb. per sq. in. with either of these materials or, if he is an excellent operator, his test should develop approximately the full strength of the plate, 60,000 to 65,000 lb. per sq. in.

What the limitations should be for a qualification test with other forms of welding should be left to those thoroughly familiar with the electric arc welding or the hammer welding process as the case may be.

From these standard A. S. T. M. tests we obtain figures which can be depended on to satisfy us as to the ability of any given welder and by building up a series of qualifica-

tion tests we will be building up a history for the welding industry that will materially assist in carrying it ahead in the esteem of engineers. When a welder is making his qualification test, attention should be paid to several things that will have an important bearing on the question of workmanship. Whoever supervises the test should set a maximum time within which the test should be completed because a welder should be expected to do a certain minimum day's work. Attention should also be paid to the size of the welding head which is used for the test work. Manufacturers of blowpipes, will, undoubtedly, specify a certain welding head for any given thickness of metal and



The top view shows method of laying out test pieces on the test weld—The lower view shows the proper position in which to place the test pieces to be welded

it is advisable to have a test conducted under the conditions considered most satisfactory.

Experienced welders know that by using a very carefully adjusted flame, with gas pressures as low as can be carried and still permit operation of the torch without backfiring, a very high quality weld can be made. Such men also know that by taking their time they can make a better weld than they will generally average. The qualification test should not be intended to show what is the very best that a man can do, so much as what he can be counted on to do under working conditions.

Thus, by having the welding heads as called for by the equipment markers and using the pressures specified by them and insisting upon a commercial speed of welding a test piece will be made which gives real information.

We can rest assured, moreover, that if a man makes a satisfactory test piece, even if he has worked a little slower or with a slightly different flame than is his general practice, we will be very much better off than if he did not make a satisfactory qualification test of any kind.

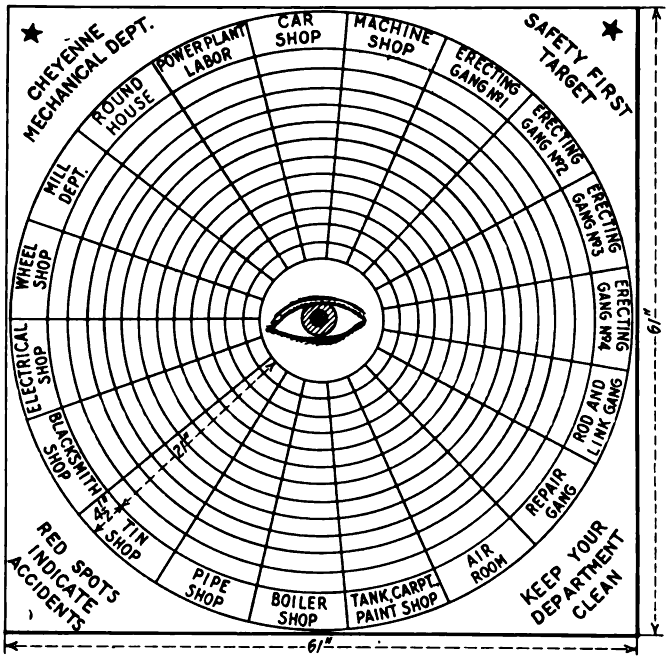
From consideration of the above, it is easy to see that we may divide the work into at least two categories. One is work which must be of the very best quality; here it is important to have the full qualification test and it will be satisfying to everyone to have such tests supervised by competent inspection laboratories. For the other class of work where life is not endangered by the failure of a joint, it is advantageous to have a good check on the welder's ability, but the simpler test which is made by cutting the test piece into strips and bending in a vise is sufficient.

The history of the welding process where real qualification tests have been utilized over a period of years is so satisfactory that we can truthfully say welding is equal in quality to any other type of joint and, of course, in tightness is far superior.

Safety-first target

ONE of the first things to strike the attention of a visitor at the Union Pacific shops at Cheyenne, Wyo., is the large safety-first target illustrated. This target is painted on a substantial board 61 in. square, located near the center of the locomotive shop where it can be readily seen by all who pass the tool room. The background in the circle is black, the corners being green, and lines and letters, white. It will be noted that all the sub-divisions of the shop organization are shown on this target and competition in safety work is thus encouraged between the different gangs. The radii of the circle are divided into 12 spaces, one for each month, and when a reportable accident occurs in one of the shop gangs a red spot in the appropriate space indicates that that gang has overlooked one dangerous practice, and must be on the alert to avoid another.

The results of the safety campaign at Cheyenne shops have been highly commendable, the last reportable personal injury occurring on October 11, 1924. The man-hours worked since are shown in the table:



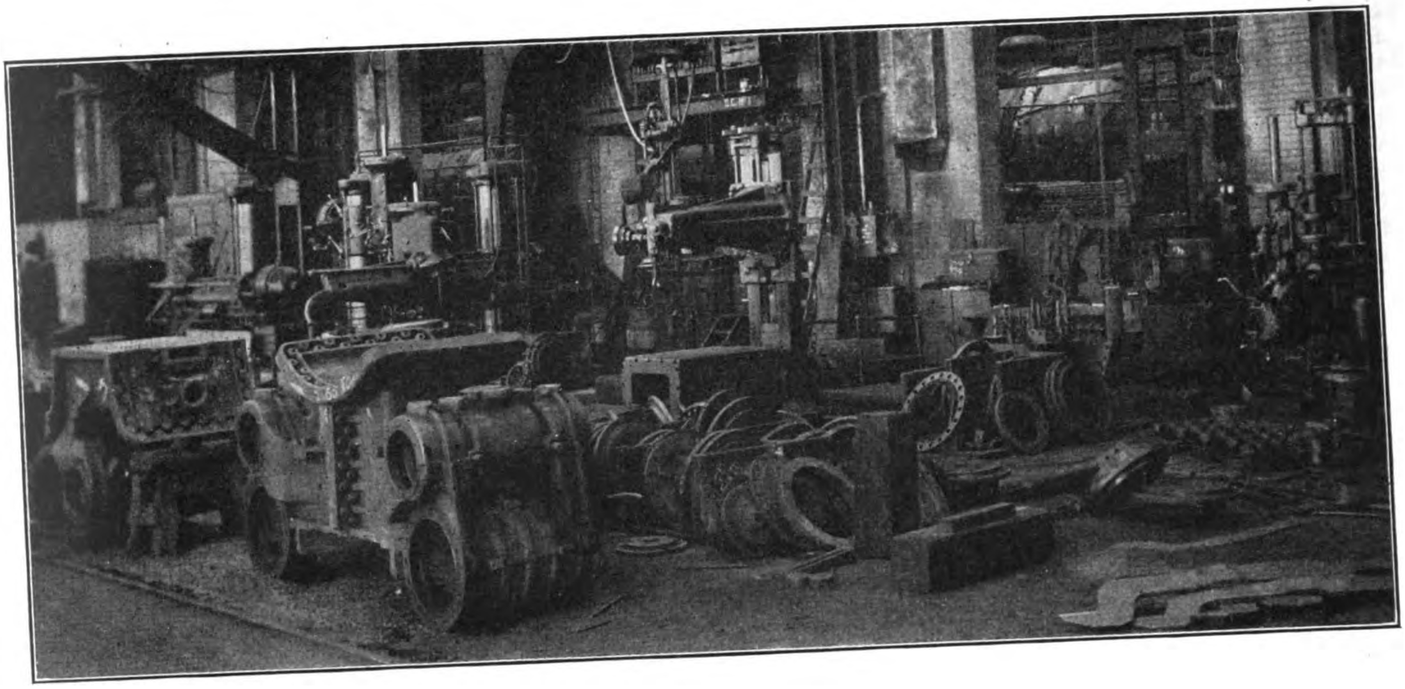
A target which shows the standing of all departments of the locomotive shop with respect to personal injury accidents

Man-hours since last reportable injury—Cheyenne shops, Union Pacific

October, 1924	258,369
November, 1924	191,137
December, 1924	180,526
January, 1925	189,962
February, 1925	208,142
March, 1925	215,426
*April, 1925	189,596

*The last month for which figures were available when this article was prepared.

One way in which it has been found practicable to direct additional attention to the safety-first target is to post notices regarding matters of general interest, such as inter-department ball games, safety-first meetings, etc., under the target. These news items are changed from day to day and the men therefore get in the habit of watching the board.



The year's purchases of machine tools

Lists from 88 roads show practically the same number of units bought in 1925 as were bought in 1924

By L. R. Gurley

LAST year's January issue of the *Railway Mechanical Engineer* contained for the first time, a tabulation of machine tools purchased by 85 railroads in North America, which represented 77 per cent of the total route mileage on this continent. Through the co-operation of the railroads it is now possible to publish similar lists for another year.

The data now available, which represents two years' purchases, is not sufficient from which to draw any final conclusions as to the trend with respect to the types of machines purchased or the long time trend of the railway market as a whole. However, certain interesting indications begin to appear. Using the 1924 list of machine tools purchased as a basis of comparison, the number of tools of the same classes purchased this year is only 33 units or two per cent less than those reported for 1925. Furthermore, the proposed machine tool expenditure for 1926 compares closely with the expenditures which were proposed a year ago for 1925. The budget figures for the purchases of machine tools by 19 railroads in the United States, which represent 27 per cent of the total route mileage, show proposed expenditure of $3,142,796 for 1926, as compared with $3,162,382 which the same roads proposed to spend during 1925. These facts indicate that the railway purchases of machine tools are not affected by the same conditions as was the car and locomotive market during the past year, and point strongly to the stability of the railroad market for machine tools.

The list of the various types of machine tools purchased has been enlarged to include not only blacksmith, boiler and car shop metal working or forming machinery such as bulldozers, bolt machines, steam hammers, flue welding machinery, punches, shears, riveters, presses, etc., and car shop woodworking machines, as well as the metal cutting machines commonly classified as machine tools, but also to include other shop facilities such as shop trucks, overhead cranes, car and locomotive hoists and small shop hoists, together with furnaces, motors, generating sets, air compressors and welding equipment.

Comparison of types purchased

On page 105 of the January 2, issue of the Railway Age will be found an article on "Machine Tools Purchased During 1925" which contains two tables giving in total numbers the various types of machine tools and shop equipment purchased by 88 railroads in North America which represent 77 per cent of the total route mileage. These figures show that the railroads purchased 310 lathes, 179 drill presses, 104 planers, shapers and slotters, 69 boring mills, 38 milling machines, 291 grinding machines, 58 portable boring, facing and turning machines, 93 bolt and pipe cutting and threading machines, 82 power presses, 56 hammer and forging machines, 119 boiler shop machines, including punches and shears and 160 woodworking machines. The shop equipment figures show that the railroads also purchased 97 blowers for forges, ventilating systems, etc., 159 furnaces, 23 overhead cranes, 14 car and locomotive hoists, 230 air, electric and chain hoists, 131 shop trucks, 85 truck trailers, 24 air brake test racks, 54 air compressors, and 110 electric welding sets.

There are certain machine tools which are standard equipment to all railway shops, the purchase of which varies but little. For example, 337 lathes, 178 drill

presses, 127 planers, shapers and slotters and 80 boring mills were purchased in 1924, as compared with 310, 179, 104 and 69, respectively, of the same tools purchased during 1925.

During the past few years, considerable attention has been given to the place which grinding machines should take in the railroad shops. That this is making itself felt in the selection of production machines for the railroad shops, is evidenced by the fact that during 1924, 240 grinding machines were purchased, while the 1925 purchases were 291.

To facilitate the servicing of locomotives at terminals, as well as for use in the back shop, the railroads are buying portable tools, such as lathes, boring, facing and turning machines and welding equipment. Last year 58 portable boring, facing and turning machines, 5 portable lathes and 110 electric welders, were purchased.

In spite of the tendency to replace wood cars with steel cars the purchase of woodworking machinery has increased from 146 units in 1924 to 160 units in 1925. As pointed out last year, wooden passenger cars are fast disappearing but it will be many years before freight cars are all built of steel, if, indeed they ever are. So the demand for woodworking machinery continues.

Material handling equipment

The railroads are not only purchasing modern machine tools to reduce maintenance costs but are also buying material handling devices and other shop equipment the purpose of which is to facilitate shop methods. The large number of units of this equipment listed for the first time this year indicates the type of labor-saving facilities with which the railroads are supplementing their new machine tools. Cars and locomotives can be handled by either overhead cranes or hoists. The lists include 23 of the former and 14 of the latter. The purchases also include 230 air, electric and chain hoists, used for lifting car and locomotive parts. The production of modern machines as well as repair output of the shop as a whole depends somewhat on the adequacy of intra-shop transportation facilities for the movement of material. In the past, this transportation has been provided by hand trucks which the railroads have been somewhat slow in replacing with power trucks. That some improvement is being effected, however, is evidenced by the fact that 114 electric trucks and 16 gasoline trucks were purchased last year, together with 85 trailers for use with the power trucks.

Furnaces and blowers are used extensively in the boiler shop, flue shop, blacksmith shop and in the car department. Among the smaller types of furnaces are listed 29 electric, 63 oil, as well as a number of equipments for such purposes as tempering and brass melting, some of which are gas fired. The larger type of furnaces listed include 17 furnaces for plate heating, annealing and forging work. The railroads purchased 26 pressure blowers and 31 forge blowers.

The railroads bought 24 air brake test racks last year. Fifty-four air compressors of various types were also purchased for shop use.

The lists show the purchase of 110 electric welders. Two complete acetylene gas generating sets were also included. As these plants, however, are frequently not owned by the railroads where they are installed, others may have been placed in service during the year, under leasing arrangements. Much small gas welding equipment, such as torches, regulators, gages, etc., has not been listed because of space limitations.

The lists included with this article give in as complete detail as possible the number, size or other capacity designation and type or kind of equipment purchased by each railroad during 1925 for which the data are available. The name of the builder or company from which the equipment was purchased is included where possible.

The machine tools and shop equipment purchased by the railways in 1925

Alabama, Tennessee & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in. by 6-ft.	Engine lathe	Carroll & Jamieson

Alton & Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Upright drill	W. F. & J. Barnes Co.
1	No. 3	Tool grinder	U. S. Electrical Tool Co.

Ann Arbor

No.	Size and capacity	Type of machine	Builder or dealer
1	6-ft.	Radial drill	Emerson Tool Works
1	No. 18	Hack saw	F. C. Atkins & Co.

Atchison, Topeka & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
2		Car Axle and journal turning lathes	Niles-Bement-Pond Co.
2	16-in. by 6-ft.	Portable engine lathes	Manning, Maxwell & Moore
1	20-in. by 8-ft.	Engine lathe	Niles-Bemont-Pond Co.
1	24-in. by 16-ft.	Engine lathe	Cisco Machine Tool Co.
1	32-in. by 14-ft.	Engine lathe	Manning, Maxwell & Moore
1	36-in. by 16-ft.	Engine lathe	Manning, Maxwell & Moore
1	6-ft.	Radial drill press	Smith-Booth-Usher Co.
3	24-in.	Sensitive drill presses	E. L. Essley Machinery Corp.
1		Upright drill press	Smith-Booth-Usher Co.
1	32-in.	Single head shaper	Stocker-Rumely-Wachs & Co.
1	32-in.	Invisible type crank shaper	Marshall & Huschart Mchy. Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	24-in.	Crank slotter	Marshall & Huschart Mchy. Co.
1	48-in.	Car wheel boring machine	Niles-Bement-Pond Co.
1	60-in.	Vertical boring mill	Cincinnati Planer Co.
1		Single wet emery grinder	Manning, Maxwell & Moore
5		Double end emery grinders	Scott-Ransbach Machinery Co.
1		Metal cutting off saw	Smith-Booth & Usher Co.
5	2-in.	Double head bolt cutters	Marshall & Huschart Mchy. Co.
2		Double head bolt cutters	Herberts Machinery & Supply Co.
1	6-spindle	Nut tapping machine	Manning, Maxwell & Moore
2	No. 302-B	Pipe and nipple machine	Manning, Maxwell & Moore
1	1½-in.	Bolt heading machine	Manning, Maxwell & Moore
1	100-ton	Driving box press	Manning, Maxwell & Moore
1		Portable crank pin press	Watson Stillman Co.
1	4,000-lb.	Steam hammer	Manning, Maxwell & Moore
1		Couple yoke riveter	Hanna Engineering Works
1		Pneumatic flue swedging machine	Manning, Maxwell & Moore
1		Flue furnace (oil)	Mahr Manufacturing Co.
1		Furnace (oil)	DeRemer & Blatchford Co.
1	4-ft. by 40-ft. by 30-in.	Annealing furnace	Mahr Manufacturing Co.
1	11-ft. by 11-ft.	Plate annealing furnace	DeRemer & Blatchford Co.
1	No. 70	Draft and motor fan	Buffalo Forge Co.
4		Electric ventilating fans	Garden City Fan Co.
7		Pressure blowers	Mahr Manufacturing Co.
12		Soot blowers	Diamond Power Specialty Co.
1		Hand power post drill	H. Channon Company
1		Heavy compound type post borer	Greenlee Brothers Co.
1	20-in. my 6-ft.	Single surfacer	Yates Machine Co.
1	No. 177	Double surfacer	Yates Machine Co.
2	16-in.	Rip and cut-off saws	Yates Machine Co.
2	Double Arbor	Universal saw benches	Greenlee Brothers Co.
1		Self feed rip saw	Yates Machine Co.
1	15-ft.	Planer and matcher	Yates Machine Co.
1	No. 91	Planer and matcher	Yates Machine Co.
1	C-4-A	Moulder	Yates Machine Co.
1	No. 430	Belt sander	Yates Machine Co.
1		Shavings exhaust system	Chicago Blow Pipe Co.
1	30-ton	Electric traveling crane	Manning, Maxwell & Moore
1	12-ton	Heavy turntable	Canton Foundry & Machine Co.
2	½-ton	Air hoists	Chicago Pneumatic Tool Co.
1	1-ton	Air hoist	Chicago Pneumatic Tool Co.
1	1-ton	Air hoist	Independent Pneumatic Tool Co.
22	1½-ton	Air hoists	Independent Pneumatic Tool Co.
5	2-ton	Air hoists	Independent Pneumatic Tool Co.
4		Air hoists	Chicago Pneumatic Tool Co.

Atchison, Topeka & Santa Fe (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 5	Universal air motor and winch	Chicago Pneumatic Tool Co.
1	2-ton	Geared hoist	Chicago Pneumatic Tool Co.
1	2-ton	Stiff leg post crane	Chicago Crane & Hoist Co.
5	1½-ton	Bracket cranes	Joseph T. Ryerson & Son
1	2-ton	Geared trolley	Scully Steel & Iron Co.
3		Gearey trolleys	Higgins & Co.
26		Bracket cranes, geared trolleys	Joseph T. Ryerson & Son
1		Hand traveling crane	Whiting Corporation
2		Propelled trucks	Elwell Parker Electric Co.
6	3½-ton	Trailers	Mercury Manufacturing Co.
1	3-U.	Test rack	Westinghouse Air Brake Co.
2		Triple valve test racks	Westinghouse Air Brake Co.
2		Air compressors	Chicago Pneumatic Tool Co.
1		Truck battery charging plant	Electric Products Co.
1	3-hp.	Induction motor	General Electric Co.
1	3-hp.	Motor	Allis Chalmers Manufacturing Co.
1	20-hp.	D. C. Motor	Westinghouse Electric & Mfg. Co.
1	25-hp.	D. C. Motor	Westinghouse Electric & Mfg. Co.
1	30-hp.	Motor	General Electric Co.
1	40-hp.	Motor	Westinghouse Electric & Mfg. Co.
2	40-hp.	D. C. Motor	Western Electric Co.
1	75-hp.	Motor and starter	Westinghouse Electric & Mfg. Co.
1		Motor and starter	Westinghouse Electric & Mfg. Co.
1	500-k. v. a.	Generating set	Westinghouse Electric & Mfg. Co.
1	7½-k.w.	Turbine generator set	Brown Hoisting Machine Co.
1		Motor generator set	Electric Products Co.
1		Electric welding generator set	General Electric Co.
1		Welding motor-generator set	Westinghouse Electric & Mfg. Co.
3	25-k. v. a.	Transformers	Westinghouse Electric & Mfg. Co.
1		Electric arc welder	Westinghouse Electric & Mfg. Co.
1		Portable elec. arc welder	General Electric Co.
3		Electric butt welding machines	Thompson Electric Welding Co.
1		Testing machine	Tinius Olsen Testing Machine Co.

Atlanta & West Point

No.	Size and capacity	Type of machine	Builder or dealer
1	6-in. by ¼-in.	Nibbling and trimming machine	
1		Stay bolt threader	Warner & Swasey Co.
1	3,500-lb.	Pneumatic press	Southwark Foundry & Machine Co.
1	35-ton, 8-in. ram	Hydraulic spring testing press	
1	100-ton, 12-in. ram	Hydraulic spring stripping press	
1	7¼-in. by 14⅛-in.	Hydraulic spring banding press	
1	⅜-in. by 7-in. by 72-in.	Elliptic spring former	
1	4-ft. by 15-ft.	Annealing furnace	Deremer-Blatchford Co.

Atlantic City Railroad

No.	Size and capacity	Type of machine	Builder or dealer
1	⅛-in. to 2½-in.	Tool and twist drill grinder	Bridgeport Safety Emery Wheel Co.

Atlantic Coast Line

No.	Size and capacity	Type of machine	Builder or dealer
2	14-in. by 6-ft.	Lathes	Rahn-Larman Co.
2	18-in. by 10-ft.	Tool room lathes	Manning, Maxwell & Moore
1	24-in. by 26-in.	Libly Type C lathe	Manning, Maxwell & Moore
1	20-in.	American lathe	Regar Co.
2	20-in.	Brass lathes	Manning, Maxwell & Moore
3		Lehman lathes	Carey Machine & Supply Co.
1		Turret lathe	Warner & Swasey
2	6-ft.	Radial drills	Smith-Courtney Co.
1	No. 3	Swing drilling machine	Manning, Maxwell & Moore
1	6-spindle	Arch bar drilling machine	Niles-Bement-Pond Co.
2	32-in.	Shapers	Ohio Machine Tool Co.
1	36-in. by 44 in.	Side head boring mill	Niles-Bement-Pond Co.
1	52-in.	Car wheel boring machine	Consolidated Machine Tool Corp.
1		Driving box borer & facer	Wm. Sellers & Co., Inc.
1		Vertical rod miller	Consolidated Machine Tool Corp.
1		Piston rod grinder	Norton Co.
2	FG	Internal grinders	Manning, Maxwell & Moore
1	No. 475	Oilstone tool grinder	Manning, Maxwell & Moore
1		Side head grinder	
3		Chambersburg wheel presses	Manning, Maxwell & Moore
1	2-ton	Chambersburg steam hammer	Manning, Maxwell & Moore
1	type D	Adjusting machine	Walter Stock Adjusting Machine Co.
1	No. 5	Beam and plate punch	Consolidated Machine Tool Corp.
1	No. 40	Rotary shear	Manning, Maxwell & Moore
1	No. 14	Bar shear	Consolidated Machine Tool Corp.
1	No. 26	Combined punch and plate shear	Henry Pels & Co.
1	No. 7	Plate bending rolls	Consolidated Machine Tool Corp.
1	2,500-lb.	Plate bending rolls	Monarck Engineering & Mfg. Co.
1		Tempering furnace	Strong, Carlisle & Hammond Co.
2	No. 2	Electrode rivet heaters	American Car & Foundry Co.

Boston & Maine

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal lathe	Manning, Maxwell & Moore
2		Putnam axle lathes	Manning, Maxwell & Moore
1	8-in.-26-in.	Libby turret lathe	International Machine Tool Co.
1	4¼-in. by 8-in., to 5½-in. by 10-in.	Journal broaching machine	Ar-An-Ess Manufacturing Co.
1	32-in.	Stockbridge shaper	Niles-Bemnet-Pond Co.
1	42-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1		Sunstrand internal grinder	Manning, Maxwell & Moore
1	12-in. by 36-in.	Multi-purpose grinder	Norton Company
1	30-in.	Knife grinder	S. A. Woods Machinery Co.
1	Type A	Traverse grinder	Norton Company
1	No. 2	Horizontal cock grinder	Turner Foundry & Machine Co.
1		Valve finishing machine	Walter H. Foster Co.
1	K	Band saw filer and setter	Oliver Machinery Co.
1		Band saw brazer	Oliver Machinery Co.
1		Filing machine	Machinery Dealers, Inc.
1	8-in. by 8-in.	Hack saw	W. Robertson Machine & Fdy. Co.
1	8-in. by 18-in.	Hack saw	W. Robertson Machine & Fdy. Co.
4	No. 2	Crank pin turning machines	H. B. Underwood Corp.
1	4-spindle	Bolt turning machine	Walter H. Foster Co.
1	6-spindle	Turning and threading machine	Walter H. Foster Co.
1		Centering machine	Walter H. Foster Co.
1	Type A	Pipe bender	American Pipe Bending Mach. Co.
1	No. 2	Spring former	J. T. Ryerson & Son
1	1,500-lb.	Steam hammer	Chambersburg Engineering Co.
2	400-lb.	Hammer	Nazel Engineering & Mach. Works
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	20-in. by 16-in.	Timber sizer	P. B. Yates Machine Co.
1	No. 71	Wilkins channeler	P. B. Yates Machine Co.
3	3,000-lb.	Crane trucks	Elwell Parker Electric Co.

Buffalo, Rochester & Pittsburgh

No.	Size and capacity	Type of machine	Builder or dealer
1	200-ampere	Arc welder	Westinghouse Electric & Mfg. Co.

Canadian Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 4	Niles car wheel lathe	J. Bertram & Sons
1	2½-in.	Turret lathe	Acme Machine Tool Co.
1	No. 1-A	Turret lathe	Warner & Swasey Co.
1	20-in.	Vertical drill	Williams & Wilson, Ltd.
1	48-in. by 48-in. by 12-ft.	Planer	Canadian Machy. Corp.
1	26-in.	Shaper	J. Bertram & Sons
1	36-in.	Shaper	Canadian Machy. Corp.
1	60-in.	Boring mill	J. Fertram & Sons
1	54-in.	Knife grinding machine	Rogers Machinery Co.
1		Chaser grinder	Geometric Tool Co.
1		Cock grinder	Warner & Swasey Co.
1		Band saw filing machine	The Wardwell Manufacturing Co.
2	16-in.	Swing cut-off saw	Jackson Cochrane Co.
2	9-in.	Hack sawing machines	Racine Tool & Machine Co.
1	2-in.	Pipe threading machine	Landis Tool Co.
1	6-in.	Pipe threading machine	Williams Tool Corp.
1	4-in.	Centering machine	Hendey Machine Co.
1	½-in. by 8-ft.	Squaring shear	Niagara Machine & Tool Works
1	No. 40	Rotary shear	Quickword Company
1	No. 1	Punching machine	J. Bertram & Sons
2	84-in.	Spring forming machine	Jos. T. Ryerson & Son
1	6-ft.	Gap rivetter	Hanna Engineering Works
1	No. 10	Blast fan	Buffalo Forge Co.
1	8-in.	Moulder	Freston Woodworking Mach. Co.
1	No. 600	Rip saw	Canadian Machy. Corp.
1		Mitre saw	Canadian Machy. Corp.
1		Tenoner	Preston Woodworking Machy. Co.
4	25-ton	Car hoists	Whiting Corp.
9	5-ton	Pneumatic hoists	Chicago Pneumatic Tool Co.
1	5-ton	Caterpillar tractor	Holt Manufacturing Co.
2	200-amp. d.c.	Welding sets	General Electric Co.

Central of Georgia

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3	Double axle lathe	Niles-Bement-Pond Co.
1	14-in. by 6-ft.	Engine lathe	American Tool Works
2	15-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	16-in. by 8-ft.	Engine lathe	American Tool Works
1	102-in.	Tire turning machine	Niles-Bement-Pond Co.
1	1½-in. by 10-in.	Universal turret-screw machine	Warner & Swasey Co.
1	4-ft.	Radial drill	American Tool Works
1	52-in.	Boring mill	King Machine Tool Co.
1	30-in.	Bar grinder	Diamond Machine Co.
1		Internal grinder	Gisholt Machine Co.
5	18-in. by 3-in.	Floor grinder	Hisey-Wolf Machine Tool Co.
1	4-in. by 8-ft.	Boring bar	H. B. Underwood Corp.

No.	Size and capacity	Type of machine	Builder or dealer
2		Blowers	P. H. & F. M. Roots Co.
1	No. 283-P	Car mortiser	Greenlee Brothers & Co.
1	5-ton	Electric traveling crane	Niles-Bement-Pond Co.
1	7½-ton	Electric traveling crane	Niles-Bement-Pond Co.
1	5-ton	Pneumatic hoist	Detroit Hoist & Machine Co.
3	2,000-lb	Electric hoists	Shepard Electric Crane & Hoist Co.
1	1-ton	Hand operated crane	Armington Engineering Co.
6		Portable electric welders	Westinghouse Electric & Mfg. Co.

Baltimore & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal lathe	Manning, Maxwell & Moore
1	16-in. by 6-ft.	Engine lathe	Girard Machinery Co.
1	26-in. by 12-in.	Cisco-geared head engine lathe	Girard Machinery Co.
2		Bench lathes	L. A. Benson Co.
1	4-ft.	Dresses radial drill press	Manning, Maxwell & Moore
1	20-in.	Barnes Upright drill press	Manning, Maxwell & Moore
1	15-in. by 18-in.	Upright drill press	Kemp Machinery Co.
1	24-in.	Columbia high-duty shaper	Manning, Maxwell & Moore
1	24-in.	Columbia crank shaper	Manning, Maxwell & Moore
1	36-in.	Open-side crank planer and shaper	Manning, Maxwell & Moore
1		Draw-cut shaper	Morton Mfg. Co.
1	48-in.	Car wheel borer	Manning, Maxwell & Moore
1	100-in.	Vertical boring & turning mill	Wm. Sellars & Co., Inc.
1	No. 2	Universal grinding machine	Landis Machine Co.
1	No. 6	Dexter valve reseating machine	Leavill Machine Co.
8	No. 131	Ramson dry grinding machines	Motch & Merrymaker Mchy. Co.
1		Grinding machine	Wm. Sellars & Co., Inc.
1		Saw blade redressing machine	J. T. Ryerson & Sons
1	6-in. by 6-in.	Peerless metal saw	Manning, Maxwell & Moore
1	Type BH	Portable rail saw	The Aldon Co.
1	No. 2	Underwood cyl., dome facing mach.	Storer Machinery Co.
1	No. 3	Underwood loco. dome facing mach.	Storer Machinery Co.
1	No. 4	Underwood portable cyl. facer	Storer Machinery Co.
1	3½-in. by 6-ft.	Underwood loco. cyl. boring bar	Storer Machinery Co.
1	3½-in. by 6-ft.	Locomotive boring bar	Manning, Maxwell & Moore
1	4-in. by 6-ft.	Locomotive boring bar	Manning, Maxwell & Moore
1	No. 4	Nicholson arbor press	L. A. Benson Co.
1	No. 3	Foot power mitering machine	J. A. Fay & Egan Co.
1	No. 321	Hand power mitering machine	J. A. Fay & Egan Co.
1	18-in.	Hand planing and jointing mach.	J. A. Fay & Egan Co.
2	36½-in. by 21½-in. by 27-in.	Air compressors	Ingersoll-Rand Co.
2		Painting equipments	W. N. Matthews Corp.
3	12-in.	Belt lacers	Peerless Belt Lacing Machine Co.

Bangor & Aroostook

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 2	Crank pin turner	Manning, Maxwell & Moore
1	4½-in. by 6-ft.	Locomotive boring bar	H. B. Underwood Corp.
1	Type B	Blacksmith hammer	Blacker Engineering Co.
1	14-in.	Draft saw	American Wood Working Machine Co.
2	3T	Triple test racks	Westinghouse Air Brake Co.

Boston & Albany

No.	Size and capacity	Type of machine	Builder or dealer
1	45-in.	Axle journal truing lathe	Consolidated Machine Tool Corp.
2	18-in.	Engine lathes	The Bradford Machine Tool Co.
1	20-in.	Engine lathe	Boye & Emmes
1	24-in.	Engine lathe	Reed-Prentice Co.
1	No. 4	Turret lathe	Warner & Swasey Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1		Single Spindle loco. rod boring machine	Baker Brothers
2	36-in. by 36-in. by 12-ft.	Planers	Niles-Bemnet-Pond Co.
1	32-in.	Shaper	Cincinnati Shaper Co.
1	50-in.	Horizontal milling machine	Cincinnati Milling Machine Co.
1	No. 51	Drill pointer	Oliver Instrument Co.
1	¼-in. by 2½-in.	Twist drill grinder	
1	8-in. by 8-in.	Metal cutting machine	E. C. Atkins Co.
1	1½-in. to 2½-in.	Double head bolt cutter	Niles-Bemnet-Pond Co.
1	1¼-in. to 6-in.	Pipe threading machine	Oster Manufacturing Co.
1	15-in.	Shear	Hilles & Jones
1	No. 2	Punch and shear	Long & Allstatter Co.
1	No. 2	Nibbling machine	Andrew C. Campbell Co.
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	42-in.	Band saw	American Wood Working Mach. Co.
1	10-in. by 12-in.	Gaining machine	J. A. Fay & Egan Co.
1	4,000-lb.	Air hoist	Ingersoll-Rand Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	4-spindle	Bolt turning machine	Walter H. Foster Co.
2	½-in. to 2½-in.	Bolt cutter	Acme Machine Tool Co.
1	No. 20	Punch and shear	Henry Pels & Co.
1	No. 2	Electric rivet heater	American Car & Foundry Co.
1	No. 3	Electric rivet heater	American Car & Foundry Co.
1	54-in.	Vertical band resaw	P. B. Yates Machine Co.
1	5-in.	Finishing surfacer	P. B. Yates Machine Co.
1	3,000-lb.	Crane	Automatic Transportation Co.
11	4,000-lb.	Electric trucks	Baker, R. & L. Co.
1	No. 3	Air brake test rack	New York Air Brake Co.
1	23-in.	Air compressor	Hardie-Tynes Manufacturing Co.
1	1,200 r.p.m.	Synchronous motor generator set	Westinghouse Electric & Mfg. Co.
1	200-amp.	Welding outfit	Westinghouse Electric & Mfg. Co.

Central Railroad of New Jersey

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Journal turning and axle lathe	Niles-Bemnet-Pond Co.
1	1¼-in.	Gridley screw machine	National Acme Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	42-in.	Car wheel turning lathe	Wm. Sellers & Co., Inc.
1	42-in.	Car wheel borer	Niles-Bement-Pond Co.
1	100-in.	Vertical boring mill	Wm. Sellers & Co., Inc.
1	84-in.	Grinding machine	Diamond Machine Tool Co.
2	Type E. K.	Bench grinders	Keller Mechanical Eng. Corp.
1	6-in.	Saw	Van Dyke Churchill Co.
1	1½-in.	Bolt threading machine	Acme Machine Tool Co.
1	1,250-lb.	Steam hammer	Chambersburg Engineering Co.
1	100-ft.	Turntable tractor	R. W. Young Co.
3	1,000-lb.	Air-motor hoists	Ingersoll-Rand Co.
1	2,000-lb.	Air-motor hoist	Ingersoll-Rand Co.
4	2-ton	Chain hoists	Wright Manufacturing Co.
1	3-ton	Chain hoist	Reading Chain Hoist Co.
1	WDIO-A	Arc welding outfit	General Electric Co.

Chesapeake & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	45-in.	Betts Journal truing and axle lathe	Consolidated Mach. Tool Corp.
1	15-in. by 8-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	16-in. by 9-ft.	Engine lathe	Lehmann Machine Co.
1	90-in.	Wheel lathe	Wm. Sellers & Co., Inc.
1	5-ft.	Radial drill	American Tool Works
4	6-ft.	Radial drills	American Tool Works
1	13-ft.	Wall radial drill	Lynd-Farquhar Co.
1	32-in. by 32-in. by 40-in.	Newton crank planer	Consolidated Mach. Tool Corp.
1	36-in.	Shaper	Morton Manufacturing Co.
1	18-in.	Betts Crank slotter	Consolidated Mach. Tool Corp.
1	52-in.	Betts Boring mill	Consolidated Mach. Tool Corp.
1	60-in.	Horizontal boring machine	Lucas Machine Tool Co.
3	18-in.	Grinders	Hisey-Wolf Machine Tool Co.
1	36-in. by 4-in. by 21-in.	Wet tool grinder	Diamond Machine Tool Co.
1	2¾-in.	Drill pointer	Oliver Instrument Co.
1	13-in. by 16-in.	Hack saw	Peerless Machine Co.
1	1-in. to 4-in.	Pipe threader	Oster Manufacturing Co.
1		Portable cylinder facer	E. J. Rocksby & Co.
1	30-in.	Planing machine	H. B. Underwood Corp.
1		Horizontal staybolt machine	Gisholt Machine Co.
1	100-ton	Bushing press	Chambersburg Engineering Co.
1	48-in.	Car wheel press	Chambersburg Engineering Co.
1	600-lb.	Steam hammer	Niles-Bement-Pond Co.
1	96-in.	Shear	Niagara Machine & Tool Works
1	48-in.	Shear	Henry Pels & Co.
1		Punch and shear	Long & Alstatter Co.
1		Punch and shear	Niles-Bement-Pond Co.
1	12-ft.	Flanging clamp	Niles-Bement-Pond Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
1	24-ft.	Hilles & Jones plate bending rolls	Consolidated Mach. Tool Corp.
1	12-in.	Pneumatic mud-ring riveter	Hanna Engineering Works
1	15-in. to 18-in.	Pneumatic tank riveter	Hanna Engineering Works
1		Blower	Buffalo Forge Co.
1	12-in. by 18-in. by 4-ft.	Furnace	Ferguson Furnace Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	2,600-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	7-in. by 6-in.	Air compressor	Ingersoll-Rand Co.

Chicago, Burlington & Quincy

No.	Size and capacity	Type of machine	Builder or dealer
1	38-in.	Axle lathe	
3	55-in.	Journal and truing lathe	
1		Double end axle lathe	
2	16-in.	Engine lathes	
1	18-in.	Engine lathe	
1	1½-in.	Upright drill	

Chicago, Burlington & Quincy (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	3-in.	Upright drill	
1	4-in.	Upright drill	
4	20-in.	Upright drill presses	
1	¾-in.	Double Spindle drill	
1	32-in. stroke	Crank shaper	
2		Car wheel borers	
1	No. 2	Internal radius grinder	
1		Internal grinder	
1	10-in.	Pedestal grinder	
2	20-in.	Dry pedestal grinders	
1	24-in. by 3-in.	Wet tool grinder	
1	No. 50	Disc grinder	
1	6-spindle	Angle cock grinder	
1	24-in.	Automatic cut-off machine	
1	36-in.	Automatic cut-off machine	
1		Portable cut-off saw	
1	6-in. by 6-in.	Metal cutting machine	
1	3½-in.	Boring bar	
1	4½-in.	Boring bar	
1	6-in.	Boring bar	
1	400-ton	Wheel press	
1	200-lb.	Helve hammer	
1	No. A	Bulldozer	
1	2-in.	Forging machine	
1	2¼-in. stroke	Multiple punch	
1	30-in.	Knife shear	
1	10-gage	Serpentine shear	
1	No. 14	Punch and spacing table	
1	¾-in. plate	Flanging machine	
1	4-sided	Planer and matcher	
1	No. 502	Car gainer	
1	24-in.	Rip saw	
6	12½-in. by 18½-in.	Tolt and strippers	
1	Size D	Hand bending machine	
1		Triple valve test rack	

Chicago & Eastern Illinois

1		Journal turning and axle lathe	Niles-Bement-Pond Co.

Chicago, Indianapolis & Louisville

1		Castillo electric wheel grinder	
1	½-in. to 2-in.	Bolt threading machine	Landis Machine Co.

Chicago, Milwaukee & St. Paul

1	90-in.	Journal turning and quart'r'g mach.	
1		Journal truing lathe	
1	16-in. by 8-ft.	Toolroom lathe	American Tool Works
1	18-in. by 8-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	18-in. by 12-ft.	Engine lathe	
3	24-in. by 12-ft.	Engine lathes	
1	36-in. by 18-ft.	Engine lathe	
1	16-in.	Toolroom lathe	
1	2-in.	Turret lathe	Jones & Lamson Machine Co.
1	90-in.	Wheel lathe	Wm. Sellers & Co., Inc.
1	90-in.	Wheel lathe	
1	¾-in. by 29-in.	Turret lathe	
1	7½-in.	Turret lathe	Gisholt Machine Co.
1	No. 36B	Automatic gear cutter	Gould & Eberhardt
1	3-ft.	Radial drill	Cincinnati Bickford Tool Co.
1	4-ft.	Radial drill	Fosdick Machine Tool Co.
1	54-in.	Radial drill	
2	6-ft.	Radial drill	Dresses Machine Tool Co.
2	6-ft.	Radial drill	Reed-Prentice Co.
1	20-in.	Upright drill	W. F. & J. Barnes Co.
1	21-in.	Upright drill press	
1	36-in.	Upright drill	
1	42-in.	Snyder Upright drill	W. F. & J. Barnes Co.
1	¾-in.	Sensitive drill	
1	32-in.	Crank planer	Newton Machine Tool Co.
1	10-in.	Vertical shaper	
1	28-in.	Shaper	
1	32-in.	Crank shaper	
2	36-in.	Draw cut shapers	Morton Manufacturing Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	44-in.	Boring mill	

No.	Size and capacity	Type of machine	Builder or dealer
1	30-in. by 24-in. by 10-ft.	Planer type miller	Ingersoll Milling Machine Co.
1	28-in.	Car wheel borer	Niles-Bement-Pond Co.
1	No. 3	Horizontal miller	Rockford Machine Tool Co.
1	No. 4	Horizontal miller	Cincinnati Milling Machine Co.
1		Air pump grinder	Micro Machine Co.
2		Link grinders	Gisholt Machine Co.
2	3-in. by 18-in.	Double dry grinders	U. S. Electrical Tool Co.
1	12-in. by 2-in.	Double dry grinder	U. S. Electrical Tool Co.
1	24-in. by 4-in.	Double dry grinder	U. S. Electrical Tool Co.
1		Buffing machine	U. S. Electrical Tool Co.
1	No. 18-ESB	Power hack saw	E. C. Atkins & Co.
2		Cylinder facing machines	H. B. Underwood Corp.
2	4-in. by 6-ft.	Valve boring bars	E. J. Rooksby & Co.
1	3-in.	Single head bolt cutter	Landis Machine Co.
1	No. 6	Pipe threading machine	Bingal & Keeler Co.
1	800-ton	Wheel press	Southwark Foundry & Machine Co.
1	⅜-in. by 36-in.	Nibbling machine	W. J. Savage Co.
1	24-in.	Rip saw	J. A. Fay & Egan Co.
2	10-ton	Traveling cranes	Shaw Crane Co.
1	1-ton	Electric hoist	Box Crane Co.
1	3T	Test rack	New York Air Brake Co.
2	12-in. by 10-in.	Air compressors	Chicago Pneumatic Tool Co.
1		Electric welder	Westinghouse Electric & Mfg. Co.
1		Electric welder	General Electric Co.
1	No. 444	Electric spot welder	Federal Welding Co.

Clinchfield Railroad

1	4,500-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	No. 2	Spring forming machine	Jos. T. Ryerson & Son
2	250-lb.	Single frame steam hammers	Chambersburg Engineering Co.
1	1½-in. wedge grip	Forging machine	Buffalo Forge Co.
1	Size E	Punch	Hilles & Jones Co.
14	No. 86-D	Forges	Buffalo Forge Co.
8	No. 504	Oil-burning rivet forges	Hauck Manufacturing Co.
4		Oil furnaces	DeRemer-Blatchford Co.
1	No. 3½	Exhaust fan	Buffalo Forge Co.
1	No. 5	Exhaust fan	Buffalo Forge Co.
1	No. 379B	Mortiser	J. A. Fay & Egan Co.
1	24-in. by 7-in.	Single cylinder surfacer	J. A. Fay & Egan Co.
1	No. 505	Tenoning machine	J. A. Fay & Egan Co.
1	No. 108	Band rip saw	J. A. Fay & Egan Co.
1	6-in.	Molding machine	J. A. Fay & Egan Co.
1	No. 452F	Double spindle shaper	J. A. Fay & Egan Co.
1	No. 453	Belt sander	J. A. Fay & Egan Co.
1	1½-ton	Electric tractor crane	Baker R. & L. Co.
1	Type DTQ	Electric tractor	Baker R. & L. Co.
4	5-wheel type	Trailers for electric tractor	V. M. Cooper & Co.
1	20-in. by 12-in. by 18-in.	Compressor	Hardie-Tynes Mfg. Co.
1	25-in. by 15½-ft. by 20-in.	Compressor	Hardie-Tynes Mfg. Co.

Colorado & Southern

2	200-amp.	Electric welding machines	Westinghouse Electric & Mfg. Co.

Dansville & Mount Morris

1	16-in.	Lathe	Davis Metal Tool Co.
1	26-in.	Upright drill press	American Glyco Metal Co.

Delaware & Hudson

1	42-in.	Journal truing and axle lathe	Niles-Bement-Pond Co.
1		Drill press	Simmons Machine Tool Co.
1	39½-in.	Crank planer	Newton Machine Tool Works
1	54-in. by 34-in. by 18-ft.	Planer	Wm. Sellers & Co., Inc.
1	No. 136	Ransom grinding machine	Niles-Bement-Pond Co.
1		Swing frame grinder	L. Best & Co.
1	No. 9	Racine hack saw	Manning, Maxwell & Moore
2	Nos. 1 and 2	Underwood air pump boring bars	Manning, Maxwell & Moore
1	4-in. by 6-ft.	Underwood boring bar	Manning, Maxwell & Moore
1	48-in., 500-ton	Car wheel press	Niles-Bement-Pond Co.
1	36-in.	Cut-off saw	Greenlee Bros. & Co.
1	No. 500	Variety saw	J. A. Fay & Egan Co.
1	P-16	Timber sizer, planer and matcher	P. B. Yates Machine Co.
1	300 cu. ft.	Air compressor	Ingersoll-Rand Co.
1	450-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	2,000 cu. ft.	Air compressor	Ingersoll-Rand Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 36-in.	Universal grinder	
1	1½-in.	Universal cutter and reamer grinder	
1	No. 1	Tool grinding and shaping machine	Wm. Sellers & Co., Inc.
1	12-in. wheel	Electric floor grinder	
2	18-in. wheel	Electric grinders	
2	24-in. wheel	Electric floor grinders	
1	No. 3	Hack saw	Racine Tool & Machine Co.
1	No. 4	Hack saw	Armstrong-Blum Mfg. Co.
1	6-in.	Triple head bolt cutter	
1	1,100-lb.	Steam hammer	Chambersburg Engineering Co.
1	3,300-lb.	Steam hammer	Chambersburg Engineering Co.
1	600-ton	Wheel press	Chambersburg Engineering Co.
1	No. 5	Punch press	Rockford Tool Co.
1	8 ft.	Squaring shear	
2	48-in.	Single punch and shear	Hilles & Jones Co
3	48-in.	Double punch and shear	Hilles & Jones Co.
1	72-in.	Edging machine	Dries & Krump Mfg. Co.
1	10-ft.	Power brake	
1	¾-in.	Flanger	McCabe Manufacturing Co.
1	14-ft.	Vertical bending roll	
3		Gas furnaces	
1		Oil tempering furnace	
1	7½-ton	Jib crane	Whiting Corp.
1	3,000-lb.	Electric truck	Baker R. & L. Co.
1		Gasoline tractor	Ford Motor Co.
1		Motor	Westinghouse Electrical Mfg. Co.
4	300-amp.	Electric welders	
7		Electric welders	

Chicago, River & Indiana

1	No. 4 E. R.	Cutter and tool grinder	Gallmeyer & Livingston Co.
1	No. 10-C	Motor-driven saw	Racine Tool & Machine Co.
1	3,000-lb.	Electric truck	Baker R. & L. Co.
1		Cutler-Hammer battery charger	Baker R. & L. Co.

Chicago, Rock Island & Pacific

1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	16-in. by 8-ft.	Engine lathe	E. L. Essley Machinery Co.
1	18-in. by 10-ft.	Morris engine lathe	Niles-Bement-Pond Co.
2	90-in.	Quartering and boring machine	Niles-Bement-Pond Co.
1	24-in. by 36-in.	Upright drill press	Marshall & Huschart Machinery Co.
1		Single spindle drilling machine	Marshall & Huschart Machinery Co.
1	2-in. diameter	Mud ring drill	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 14-ft.	Planer	Niles-Bement-Pond Co.
1	100-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	Model G	Internal grinder	Manning, Maxwell & Moore.
7	No. 131	Motor-driven grinders	Ransom Manufacturing Co.
1		Car wheel grinder	
1	3¼-in. by 6-ft.	Valve chamber boring bar	Niles-Bement-Pond Co.
1	4½-in. by 8-ft.	Cylinder boring bar	Niles-Bement-Pond Co.
1	2-in.	Landis triple head staybolt threader	Hendrie & Bolthoff Mfg. & Supply Co.
1	No. 1	Horizontal punch	Niles-Bement-Pond Co.
1	No. 27	Slitting shear, punch and bar cutter	Buffalo Forge Co.
4	60-ton	Driving box and rod bush presses	Watson-Stillman Co.
1	¾-in. plate capacity	Flanging press	McCabe Manufacturing Co.
8		Fordson tractors	G. T. O'Mahy, Inc.
1		Industrial tractor	International Harvester Co.
3	300-amp.	Welder	U. S. Light & Heat Corp.

Cincinnati Northern

1	18-in.	Slotter	Dill Machine Co.
1	1½-in.	Staybolt threader	Acme Machinery Co.

Cleveland, Cincinnati, Chicago & St. Louis

4	11-in. by 4-ft.	Engine lathes	R. K. LeBlond Machine Tool Co.
1	6-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	36-in.	Engine lathe	Niles-Bement-Pond Co.
1	3¼-in.	Turret lathe	Acme Machine Tool Co.
1	24-in.	Turret lathe	Steinle Turret Machine Co.
1	4¼-in. by 8-in. to 6-in. by 11-in.	Journal bearing broach	Ar-an-Ess Co.
3	5-ft.	Radial drills	American Tool Works
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	24-in.	Vertical drill	Aurora Machine Tool Co.
1		Four-spindle drill	Foote-Burt Co.

Delaware, Lackawanna & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal turning lathe	Manning, Maxwell & Moore
1	11-in. by 5-ft.	Leblond lathe	Niles-Bement-Pond Co.
1	11-in. by 5-ft.	Engine lathe	Niles-Bement-Pond Co.
1	2¼-in. by 24-in.	Turret lathe	Jones & Lamson Machine Co.
1	No. 2	Turret lathe	W. E. Shipley Machinery Co.
1	28-in.	Engine lathe	
1	5-ft.	Dresses radial drill	Manning, Maxwell & Moore
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
2	No. 2	Sensitive drills	H. Prentiss & Co.
1	60-in. by 60-in. by 12-ft.	Metal planer	Niles-Bement-Pond Co.
1	32-in.	Columbia crank shaper	Manning, Maxwell & Moore
1	32-in.	Crank shaper	
1	32-in.	Climax shaper	Swind Machinery Co.
1	36-in.	Railroad draw-cut shaper	Morton Manufacturing Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	62-in.	Horizontal boring and drill mach.	Niles-Bement-Pond Co.
1	84-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	16-in. by 40-in. by 120-in.	Piston rod grinder	Norton Co.
1	86-in.	Face grinder	Bridgeport Safety Emery Whl.Co.
1	No. 2-1	Universal grinding machine	Brown & Sharpe Co.
1	No. 13	Universal and tool grinding mach.	Brown & Sharpe Co.
1	No. 6	Bridgeport floor grinder	Manning, Maxwell & Moore
1	No. 2	Drill grinding machine	William Sellers & Co., Inc.
1		Twist drill grinder	
1	5-in. by 7-in.	Boring bar	E. J. Rooksby & Co.
1	25-in. to 30-in.	Cylinder joint facing machine	H. B. Underwood Corp.
1	26-in.	Rotary planer	E. J. Rooksby & Co.
1		Crank pin turning machine	H. B. Underwood Corp.
1	4-in.	Pipe cutting and threading mach.	Landis Machine Co.
1		Blacksmith hammer	Blacker Engineering Co., Inc.
2	50-ton	Forcing, bush., and bend. presses	Manning, Maxwell & Moore
1	4-in.	Heading, upsetting and forg. mach.	Ajax Manufacturing Co.
1	No. 16 gage	Power shear	Manning, Maxwell & Moore
1	1½-in. to 6½-in.	Flue welding machine	Jos. T. Ryerson & Son
1	2-in. to 6½-in.	Saw and tube expanding machine	Jos. T. Ryerson & Son
1	6-in.	Flue welding furnace	Jos. T. Ryerson & Son
1	No. 10 gage	Power brake	D. Nash Mchy. Co.
1	48-in.	Yoke riveter	Hanna Engineering Works
4		Rivet heating forges	Mahr Manufacturing Co.
4		Rivet forges	Hauck Manufacturing Co.
2	4-ft. by 14-ft. by 2-ft.	Annealing furnaces	Mahr Manufacturing Co.
1	1,000-lb.	Tilting and melting furnace	W. S. Rockwell Co.
1		Electric furnace	Hoskins Manufacturing Co.
1	20-in.	Band saw	R. L. Barker & Co.
1	No. 2	Rip saw	J. A. Fay & Egan Co.
1	No. 30	Universal saw bench	American Woodworking Mach. Co.
1		Universal saw	R. L. Barker & Co.
1	8-in.	Jointer	R. L. Barker & Co.
1	2-spindle	Freizing and shaping machine	J. A. Fay & Egan Co.
1		Drop pit table	Whiting Corp.
3		Elevating platform trucks	Elwell-Parker Electric Co.
1		Electric crane truck	Elwell-Parker Electric Co.
2		Electric trucks	Elwell-Parker Electric Co.
2	DYAQ	Loco. crane trucks	Baker R & L Co.
1		3-T Triple valve test rack	Westinghouse Air Brake Co.
1		Motor generator set	Electric Products Co.
1		Generator set	Hertner Electric Co.
1	200-amp.	Arc welding machine	Westinghouse Elec. & Mfg. Co.
1	300-amp.	Arc welding machine	Lincoln Electric Co.
1	Size "A"	Blue printing machine	C. F. Pease Co.

Duluth, Massabe & Northern

1	2¼-in. by 26-in.	Turret lathe	Greenlee Bros. & Co.
1	No. 475	Tool grinder	Mummert-Dixon Co.
2	2-wheel	Electric bench grinders	U. S. Electrical Tool Co.
1	¼-in. to 2-in.	Pipe threader	Oster Manufacturing Co.
7	3 Electrode	Electric rivet heaters	American Car & Foundry Co.
1	No. 88	Oil babbitt furnace	Mahr Manufacturing Co.
9		Forges	Buffalo Forge Co.
1	2,000-lb.	Air hoist	Ingersoll-Rand Co.
1	2,000-lb.	Electric hoist	American Engineering Co.
1	6,000-lb.	Elevating truck	Baker R. & L. Co.
1	No. 6	Oil renovator	Sharples Specialty Co.

Elgin, Joilet & Eastern

1	24-in.	Barnes upright drill	E. L. Essley Machinery Co.
2	No. 131	Grinders	Ransom Manufacturing Co.
1	300-ton	Forging press	Manning, Maxwell & Moore
1	1,000-lb.	Steam hammer	Manning, Maxwell & Moore

Elgin, Joliet & Eastern (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1		Pattern maker's lathe	J. A. Fay & Egan Co.
2	No. 351A	Post borers	Greenlee Bros. & Co.
1	36-in.	Wood band saw	J. A. Fay & Egan Co.
1	No. 223	Cut-off saw	J. A. Fay & Egan Co.
2	6-ton	Electric traveling cranes	Milwaukee Elec. Crane & Mfg. Co.
2		Triple valve test racks	Westinghouse Air Brake Co.
1	20-in. by 12-in. by 14-in.	Air compressor	Chicago Pneumatic Tool Co.
3	100-k.v.a.	Transformers	Westinghouse Electric & Mfg. Co.
3	150-k.v.a.	Transformers	Westinghouse Electric & Mfg. Co.
1	2-unit	Electric welding machine	General Electric Co.
1		Electric welding machine	Westinghouse Electric & Mfg. Co.

Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	4L	Turret lathe	Gisholt Machine Co.
2	½-in.	Sensitive drill press	Allen Manufacturing Co.
1	B-W-1	Sensitive drill press	Sipp Machine Co.
2	No. 5	Twist drill grinder	Oliver Instrument Co.
1	24-in.	Metal cutting shaper	American Tool Works
1	26-in.	Metal cutting shaper	American Tool Works
2	48-in.	Car wheel borers	Niles-Bement-Pond Co.
2	No. 2	Band saw filing machines	Black Diamond Machine Co.
1	18-in. by 3-in.	Emery wheel stand	U. S. Electrical Tool Co.
1	BK-2	Die grinder	Kellar Engineering Corp.
1	4½-in. by 8-ft.	Loco. cyl. boring bar	H. B. Underwood Corp.
1	304-B	Pipe threading machine	Oster Manufacturing Co.
2	24-in. by 30-in.	Bushing presses	Chambersburg Engineering Co.
1	15-in.	Gap shear	Niagara Machine & Tool Works
3	8¼-in. by 10-in.	Compression riveters	Allen Manufacturing Co.
2	No. 45	Exhaust fans	B. F. Sturtevant Co.
24	No. 18	Rivet forges	Mahr Manufacturing Co.
1	No. 7	Oven type furnace	Chicago Flexible Shaft Co.
1	4-ft. by 6-ft. by 1½-ft. pot	Spring temp. furn. & blower equip	Mahr Manufacturing Co.
1	¾-in.	Motor driven mortiser	Greenlee Brothers & Co.
1	No. 226	Hollow chisel mortiser	Greenlee Brothers & Co.
1	No. 2	Tenoning machine	J. A. Fay & Egan Co.
1	42-in.	Band saw	American Woodwk. Machine Co.
1	No. 60	Universal saw	Oliver Woodworking Mach. Co.
1	40-55-70	Dust and shavings collector	Kirk & Blum Manufacturing Co.
3	1-ton	Pneumatic motor hoists	Ingersoll-Rand Co.
1	2-ton	Elec. traveling hoist for gantry	Franklin Moore Co.
3	5-ton	Pneumatic motor hoists	Ingersoll-Rand Co.
1	10-ton	Electric jib crane	Whiting Corp.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.
4	4,000-lb.	Hand elevating trucks	Plimpton Lift Truck Corp.
1	6,000-lb.	Electric elevating platform truck	Elwell-Parker Electric Co.
2	No. 3-T	Triple valve test rack	New York Air Brake Co.
1	52-cu. ft.	Motor driven air compressor	Westinghouse National Brake Co.
2	176-cu. ft.	Electric air compressor	Chicago Pneumatic Tool Co.
1	15 horsepower A. C.	Electric Motor	Westinghouse Electric & Mfg. Co.
1	75 horsepower 25 cycle	Electric Motor	Westinghouse Electric & Mfg. Co.
1	24-30-cell	Charging panel	Electric Products Co.
1	14-amp. 12-volt	Motor generator set	Westinghouse Electric & Mfg. Co.
2	Model G	Paint spray machines	Eclipse Air Brush Co.
1	No. 5-A	Paint burning machine	Mahr Manufacturing Co.
1	10-horsepower	Car puller	Mining Machine Co.
3	Type D. M.	Locomotive cleaning machines	"D & M" Cleaning Process Co.
1	4-ft.	Radial drill	American Tool Works
2	5-ft.	Radial drills	American Tool Works
1	5-ft.	Centering machine	Hendey Machine Co.
5	21-in.	Vertical drill press	Superior Machine Tool Co.
8	No. 263	Upright drills	W. F. & J. Barnes Co.
1	No. 53	Staybolt drill	The Taylor & Fenn Co.
1	20-in.	Crank shaper	Hendey Machine Co.
2	24-in.	Shapers	Ohio Machine Tool Co.
1	32-in.	Shaper	Ohio Machine Tool Co.
3	36-in.	Draw cut shapers	Morton Manufacturing Co.
1	20-in.	Slotting machine	Wm. Sellers & Co., Inc.
2	24-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	36-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
2	54-in.	Vertical turret lathes	Bullard Machine Tool Co.
2	100-in	Rail tire mills	Consolidated Machine Tool Corp.
1	No. 32	Horizontal boring and drilling mach.	Lucas Machine Tool Co.
1		Boring and facing machine	Wm. Sellers & Co., Inc.
1	No. 4	Universal milling mach.	Cincinnati Milling Machine Co.
2	No. 5	Milling machines	Cincinnati Milling Machine Co.
3	No. 2	Sundstrand link and sur. grinders	Manning, Maxwell & Moore
7	No. 2	Sundstrand internal and sur. grind.	Rockford Milling Machine Co.
3	84-in.	Face grinders	Diamond Machine Co.
9	Type 7	Floor grinders	Hisey-Wolfe Machine Co.
5	5 hp.	Floor grinders	U. S. Electric Tool Co.
1	¼-in. by 2½-in.	Yankee twist drill grinder	Wilmarth-Marmon Co.
2	No. 5	Twist drill grinders	Oliver Instrument Co.
4	50-in.	Grinders	Wilmarth-Marmon Co.
5		Die chaser grinders	Geometric Tool Co.
1	Type A.	Polishing and finishing machine	Production Machine Co.
3	6-in. by 6-in.	Power hack saws	Racine Tool & Machine Co.
2		Crank pin turning machines	E. J. Rooksby & Co.
2	¾-in. by 1½-in.	Horizontal staybolt machines	Gisholdt Machine Co.
2	1½-in.	Bolt cutters	Acme Machine Co.
3	2-in.	Bolt cutters	Acme Machine Co.
1	2½-in.	Bolt cutter	Acme Machine Co.
3	No. 304-B.	Pipe threader and cutters	Oster Manufacturing Co.
1	96-in.	Driving wheel press	R. D. Wood & Co.
3	100-ton	Hydro-pneumatic forcing presses	Chambersburg Engineering Co.
2	No. 4	Arbor presses	Edwin E. Bartlett Co.
2	500-lb.	Helve hammers	C. C. Bradley & Son, Inc.
2	2,700-lb.	Steam hammers	Niles-Bement-Pond Co.
1	Type FV-42	Bar shear	Henry Pels & Co.
1	No. 37	Punch, shear and bar cutter	Buffalo Forge Co.
1	Type H. B. L. 10	Splitting and punching machine	Henry Pels & Co.
1	No. 50	Flue welder	Thompson Electric Welding Co.
1	No. 10-15	Flue welding furnace	DeRemer-Blatchford Co.
2	5¼-in.	Flue lathes	Marshalltown Manufacturing Co.
4	10-ft.	Pneumatic flanging clamps	Niles-Bement-Pond Co.
2	7-ft. 2-in.	Bending rolls	Cleveland Punch & Shear Wks. Co.
2	¾-in.	Pneumatic flanging machines	McCabe Manufacturing Co.
11	Type C-3-H.	Rivet heaters	R. C. S. Equipment Co.
2	1,000-lb.	Melting furnaces	U. S. Smelting Furnace Co.
2	3-ft. 5-in. by 6-ft. 6-in.	Hammer furnaces	DeRemer-Blatchford Co.
2	2-in.	Vertical car mortisers	Greenlee Brothers & Co.
1	30-in. by 8-in.	Surface machine	P. B. Yates Machine Co.
1	6-in.	Moulding machine	J. A. Fay & Egan Co.
1	10½-in.	Universal woodworker	J. A. Fay & Egan Co.
2	12-in.	Woodworkers	J. A. Fay & Egan Co.
1	21-in. by 13-in.	Rip saw	J. A. Fay & Egan Co.
1	No. 404, 30-in.	Rip saw bench	Greenlee Brothers & Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.
1	42-in.	Band saw	American Wood Machine Co.
2	36-in.	Band saws	Hall & Brown Woodwk. Mach. Co.
1	No. 235	Cut-off saw	P. B. Yates Machine Co.
1	No. 262	Cut-off saw	J. A. Fay & Egan Co.
1	250-ton	Locomotive hoisting crane	Whiting Corp.
1	4,000-lb.	Air motor hoist	Ingersoll-Rand Co.
1	3,000-lb.	Crane truck	Auto Transportation Co.
2	Type DYAQ.	Crane trucks	Baker R. & L. Co.
6	300-amp.	Welding outfits	U. S. Light & Heat Corp.

Ft. Worth & Denver City

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in.	Lehmann engine lathe	Dallee Machinery Co.
2	2½-in.	Daill presses	Barnes Machine Co.
1	32-in.	Shaper	Gould & Eberhardt
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
2	No. 13	Dry grinders	Ransom Manufacturing Co.
1	½-in. to 2½-in.	Bolt threader	Landis Machine Co.
1	2½-in.	Bolt threader	Landis Machine Co.
1	6-ft.	Bending rolls	Marshalltown Mfg. Co.
1	36-in.	Cut-off saw	Greenlee Brothers & Co.
3		Welding machines	General Electric Co.

Fruit Growers' Express Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	2-in.	Bolt threader	Landis Machine Co.
1	10-gage	Bending brake	Dreis & Krump Manufacturing Co.

Georgia, Florida & Alabama

No.	Size and capacity	Type of machine	Builder or dealer
1	10-horsepower	Electric arc welding machine	Bird-Potts Company, Inc.

Intermountain Railway

No.	Size and capacity	Type of machine	Builder or dealer
1		Arc welder	General Electric Co.

Kansas City, Mexico & Orient

No.	Size and capacity	Type of machine	Builder or dealer
1	3,300-lb	Steam hammer	Chambersburg Engineering Co.
1	¾-in.	Flanger	McCabe Manufacturing Co.
1	No. G-36	Band saw	P. B. Yates Machine Co.
1	No. G-15	Tilting table	P. B. Yates Machine Co.

Georgia Railroad

No.	Size and capacity	Type of machine	Builder or dealer
1		Blast fan system	Mahr Manufacturing Co.

Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 10-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	No. 3	Universal turret lathe	Cincinnati Acme Tool Co.
1	44-in.	Driving box borer and facer	Bullard Machine Tool Co.
1		Car wheel borer	Wm. Sellers & Co., Inc.
1	600-ton	Driving wheel press	Watson-Stillman Co.
2	8-in. by 12-in. by 18-in.	Electric furnaces	Hoskins Manufacturing Co.
1	10-in. by 20-in. by 20-in.	Oil bath	Hoskins Manufacturing Co.

Gulf Coast Lines

No.	Size and capacity	Type of machine	Builder or dealer
1		Axle lathe	Putnam Machine Co.
1	16-in. by 8-ft.	Engine lathe	American Tool Works
1	20-in. by 10-ft.	Engine lathe	American Tool Works
1	24-in. by 12-ft.	Engine lathe	American Tool Works
1	30-in. by 14-ft.	Engine lathe	American Tool Works
1	4-ft.	Radial drill	American Tool Works
1	36-ft. by 36-ft. by 16-ft.	Metal planer	Woodward & Powell Mach. Co.
1	32-in.	Crank shaper	Columbia Machine Tool Co.
1	18-in.	Vertical slotter	Putnam Machine Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	No. 5A	Boring and milling machine	Defiance Machine Works
1	No. 1½	Universal grinder	Cincinnati Electric Tool Co.
1		Twist drill grinder	Grand Rapids Grinding Mach. Co.
1	2-in.	Triple head bolt cutter	Landis Machine Co.
1	6-in.	Pipe threader	Landis Machine Co.
1	100-ton	Crank pin press	Elmes Engineering Works
1	No. 20	Punch and shear	Henry Pels & Co.
1	5-ton	Traveling crane	Niles-Bement-Pond
1	15-ton	Traveling crane	Milwaukee Elec. Crane & Mfg. Co.

Gulf, Colorado & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 302-B	Pipe and nipple machine	Manning, Maxwell & Moore
1		Pneumatic flue swedging machine	Manning, Maxwell & Moore
1		Mahr Manufacturing Co.	Mahr Manufacturing Co.
2	½-ton	Air hoists	Pneumatic Tool Co.
1	1-ton	Air hoist	Chicago Pneumatic Tool Co.
1	1-ton	Geared air hoist	Independent Pneumatic Tool Co.
3		Geared trolleys	Higgins & Co.
1		Electric butt welding machine	Thompson Electric Welding Co.

Gulf, Mobile & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	21-in. by 12 ft.	Engine lathe	Jos. T. Ryerson & Son
1	450,000-lb.	Turntable tractor	George K. Nichols & Bros.
1	3,000-lb.	Crane truck	Elwell Parker Electric Co.
1	25-hp.	Slip ring lathe motor	General Electric Co.
1	300-amp.	Welding unit	Lincoln Electric Co.

Hocking Valley

No.	Size and capacity	Type of machine	Builder or dealer
1	175-cu. ft.	Horizontal air compressor	Chicago Pneumatic Tool Co.
1	2,200 cu. ft.	Duplex air compressor	Chicago Pneumatic Tool Co.

Illinois Central

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Locomotive axle journal lathe	Niles-Bement-Pond Co.
1	45-in.	Axle lathe	Betts-Bridgeford Machine Co.
3	11-in. by 6-ft.	Engine bolt lathes	Niles-Bement-Pond Co.
4	16-in. by 7-ft.	Engine lathes	Lehmann Machine Co.
1	16-in. by 10-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	20-in. by 10-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	23-in. by 10-ft.	Engine lathe	Niles-Bement-Pond Co.
1	24-in. by 9-ft.	Engine lathe	Lehmann Machine Co.
4	24-in. by 10-ft.	Engine lathes	American Tool Works
1	30-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
2	30-in. by 18-ft.	Engine lathes	American Tool Works
1	36-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
1	12-in.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	2¼-in. by 24-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	3½-in. by 44-in.	Turret lathe	The Acme Machine Tool Co.
1	18-in.	All-geared turret lathe	Bardons & Oliver Machine Co.
2	90-in.	Driving wheel lathes	Niles-Bement-Pond Co.
1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
3	No. 4	Tire turning lathes	Niles-Bement-Pond Co.

Kansas City Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	400,000-lb.	Testing machine	Tinius-Olson Testing Machine Co.

Lake Superior & Ishpeming

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3	Electric rivet heater	American Car & Foundry Co.

Lehigh & New England

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 20	Floor grinder	Cincinnati Electrical Tool Co.
1	C-3-H	Electric rivet furnace	American Car & Foundry Co.
1	200-amp.	Arc welding machine	Westinghouse Electric & Mfg. Co.

Lehigh Valley

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 10-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	24-in. by 14-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	36-in. by 42-in.	Woodward & Powell crank planer	Manning, Maxwell & Moore
1	4½-in.	Defiance boring and drilling mach.	Manning, Maxwell & Moore
1	42-in.	Bullard vertical turret lathe	W. E. Shipley Machinery Co.
1	4¾-in.	Surface grinding machine	Brown & Sharpe Co.
1	No. 6.	Blount floor grinder	Manning, Maxwell & Moore
1	¼-in. to 2-in.	Oster pipe threader	Manning, Maxwell & Moore
1	1¼-in. to 6-in.	Oster pipe threader and cutter	Manning, Maxwell & Moore
1	5-ton.	Little Giant air hoist	Chicago Pneumatic Tool Co.
1	Type CK.	Electric crane truck	Elwell-Parker Electric Co.
1		Universal valve test rack	Westinghouse Air Brake Co.
1	40-hp.	Electric motor	Westinghouse Electric & Mfg. Co.
1	Single unit	Automatic charging plant	Electric Products Co.

Long Island

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Car wheel lathe	Wm. Sellers & Co., Inc.
1	⅝-in. by 7-in. by 72-in.	Elliptic spring former	Jos. T. Ryerson & Son
4	20-ton	Overhead cranes	Whiting Corp.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.
1		Generator set for electro plating	A. P. Munning Co.

Los Angeles & Salt Lake

No.	Size and capacity	Type of machine	Builder or dealer
2	18-in. by 8-ft.	Engine lathes	Monarch Machine Tool Co.
1	20-in. by 10-ft.	Engine lathe	Monarch Machine Tool Co.
1	20-in.	Brass lathe	Dresses Machine Tool Co.
1	5-ft.	Radial drill	Western Machine Tool Works
1		Drawcut shaper	Morton Manufacturing Co.
1	2-wheel	Ball bearing grinder	U. S. Electrical Tool Co.
1	18-in. to 30-in. diameter	Facing machine	H. B. Underwood Corp.
2	1⅛-in.	Triple head bolt machines	Landis Machine Co.
1		Pneumatic tube welding machine	Draper Manufacturing Co.
1	¾-in. plate	Flanging machine	McCabe Manufacturing Co.
1	9-ft. 6-in. by 12-ft.	Plate furnace	DeRemer-Blatchford Co.
1	Type X-2	Air compressor	Ingersoll-Rand Co.
1	15-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	20-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	25-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	Type WD-9	Electric welding generator set	General Electric Co.
5	WD-12	Electric welding generator sets	General Electric Co.

Louisville, Henderson & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	WD-9	Arc welder	General Electric Co.

Louisville & Nashville

No.	Size and capacity	Type of machine	Builder or dealer
2	16-in. by 8-ft.	Engine lathe	Manning, Maxwell & Moore
2	18-in. by 8-ft.	Engine lathes	New York Shipbuilding Corp.
1	18-in. by 8-ft.	Engine lathe	Brownell Machinery Co.
1	24-in. by 12-ft.	Engine lathe	A. C. Love & Co.
1	26-in. to 42-in.	Car wheel lathe	Niles-Bement-Pond Co.
1	27-in. by 12-ft.	Engine lathe	A. C. Love & Co.
5	36-in. by 17-ft.	Engine lathe	Niles Bement-Pond Co.
2	3-in. by 36-in. by 15-in.	Turret lathes	Jones & Lamson Machine Co.
1	90-in.	Driving wheel lathe	Manning, Maxwell & Moore
1	20-in.	Lead drill	Niles-Bement-Pond Co.
1	36-in. by 36-in. by 8-ft.	Planer	E. A. Kinsey Co.
1	36-in. by 36-in. by 12-ft.	Planer	Manning, Maxwell & Moore
1	38-in.	Spiral geared planer	E. A. Kinsey Co.
1	32-in.	Shaper	Ohio Machine Tool Co.
1		Milling machine	Vonnegut Machinery Co.

Louisville & Nashville (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1		Gisholt internal grinder	E. A. Kinsey Co.
1	3-hp.	Light tool grinder	Manning, Maxwell & Moore
2	7¼-in. and 6¼-in.	Tool grinders	E. A. Kinsey Co.
1	8-in. by 24-in.	Tool grinder	E. A. Kinsey Co.
2	6-in. by 6-in.	Hack saw machine	Doermann-Roehrer Co.
1	10-in. and 11½-in.	Crank pin turning machine	Walraven Co.
1	2-in.	Double-head bolt cutter	Manning, Maxwell & Moore
2	100-ton	Bushing presses	Manning, Maxwell & Moore
2	100-ton	Bushing presses	Niles Tool Works
1	400-ton	Wheel press	Manning, Maxwell & Moore
2	600-ton	Wheel presses	Manning, Maxwell & Moore
1	1,100-lb.	Steam hammer	New York Shipbuilding Corp.
2	2-in.	Bolt heading and forging machines	Ajax Manufacturing Co.
3	1½-in. to 6½-in.	Flue welding machines	Jos. T. Ryerson & Son
2	No. 6-E.	Electric forge blowers	Buffalo Forge Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	30-ton	Drop pit jack	Watson-Stillman Co.
1	100-ton	Tractor	Ford Motor Co.
1	12-in. by 17-in. by 10-in. by 14-in.	Air compressor	Bury Compressor Co.
2	175-amp.	Arc welding sets	Westinghouse Electric & Mfg. Co.
7	200-amp.	Arc welding sets	Westinghouse Electric & Mfg. Co.

Minneapolis & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in.	Draw-cut Shaper	Morton Manufacturing Co.

Michigan Central

No.	Size and capacity	Type of machine	Builder or dealer
1		Double end axle lathe	Canadian Machinery Corp.
1	24-in. by 12-ft.	Engine lathe	Monarch Machine Tool Co.
1	17-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	19-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	24-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	42-in.	Wheel turning lathe	John Bertram & Sons
1	90-in.	Putnam driving wheel lathe	Manning, Maxwell & Moore
1	5-ft.	Radial drill	American Tool Works
1	6-ft.	Radial drill	American Tool Works
2	20-in.	Upright drills	Bickford Tool Co.
1	25-in.	Upright drill	Superior Machine Tool Co.
1	16-in.	Shaper	Ohio Machine & Tool Co.
1	52-in.	Betts wheel boring machine	Consolidated Machine Tool Co.
1	100-in.	Betts tire mill	Consolidated Machine Tool Co.
3		Twist drill grinders	Oliver Instrument Co.
1		Cutter grinder	Landis Machine Co.
1	6-in.	Grinder	Van Dorn Electric Tool Co.
1	No. 156	Dry grinder	Forbes & Meyers Co.
3		Dry grinders	Forbes & Meyers Co.
2		Grinders	Forbes & Meyers Co.
1	No. 1	Circular saw sharpener	Samuel C. Rogers Co.
1		Band saw filer	Samuel C. Rogers Co.
1		Metal band saw	Stockridge Machine Co.
2	2-in.	Pipe cutting machines	Oster Manufacturing Co.
1	4-in.	Pipe machine	Oster Manufacturing Co.
1	No. 2	Hammer	Nazel Engineering Co.
1	No. 4	Hammer	Nazel Engineering Co.
1	"B"	Forging hammer	Blacker Engineering Co.
1	16-in. by 70-in.	Bulldozer	Williams, White & Co.
1	No. 2	Eye bolt machine	Williams White Co.
1	No. 2	Scrap cutting machine	Doelger & Kristen
1	No. 3	Scrap cutting machine	Doelger & Kristen
1	20-in.	Punch	Buffalo Forge Co.
1		Punching machine	Thomas Spacing Machine Co.
1		Ring and circle shear	Peck, Stow & Wilcox Co.
1		Splitting shear	Buffalo Forge Co.
1	¼-in. by 10-in.	Bending roll	Wicks Brothers
1	10-ft.	Power brake	Dries & Krump
1		Adjusting machine	Walter Stock Co.
1		Blower fan	Clarage Fan Co.
2		Blower fans	Buffalo Forge Co.
1	6-ft. by 16-ft. by 6-in.	Annealing furnace	DeRemer-Blatchford Co.
1	No. 1	Tenoning machine	Amer. Wood Working Mach. Co.
1	7-in.	Bench universal saw	J. D. Wallace Co.
1	No. 22	Poney wood planer	Baxter E. Whitney & Son
3		Fordson tractors	Ford Motor Co.
1		Tructractor	Clark Tractor Co.
1	1,000-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	1,574-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	20-kw.	Motor generator	General Electric Co.
1	50,000-lb.	Brake beam testing machine	Tinius Olsen Testing Machine Co.
1	80,000-lb.	Spring testing machine	Tinius Olsen Testing Machine Co.
1		Paint spraying machine	DeVilbiss Manufacturing Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	1,500-lb.	Steam hammer	Niles-Bement-Pond Co.
1	No. 10	Beaudry power hammer	Manning, Maxwell & Moore
2		Vertical punches	Jos. T. Ryerson & Son.
1		Shearing machine	Henry Pels & Co.
1		Doelger & Kirsten shear	Manning, Maxwell & Moore
1		Rod straightener and shear	C. E. McArthur
7	No. 20	Combination punch and shears	Henry Pels & Co.
1	No. 7	Bending roll	Niles-Bement-Pond Co.
1		Pony brake	Chicago Pneumatic Tool Co.
2	No. 5-E	Forge blowers	Buffalo Forge Co.
1		Electric forge blower	Buffalo Forge Co.
1		Pressure blower	Buffalo Forge Co.
1		Vertical chisel mortiser	Hall & Brown Woodwk. Mach. Co.
2	No. 197	Planer jointers	Hall & Brown Woodwk. Mach. Co.
1	No. 55	Tenoner	Hall & Brown Woodwk. Mach. Co.
2	No. 183	Finishing planers	Hall & Brown Woodwk. Mach. Co.
1		Woodward & Powell planer	Manning, Maxwell & Moore
1	No. 364	Cut-off saw	J. A. Fay & Egan Co.
1	No. 210	Swing saw	Hall & Brown Woodwk. Mach. Co.
1	No. 188	Shaper	Hall & Brown Woodwk. Mach. Co.
1	No. 454	Lightning spindle	J. A. Fay & Egan Co.
2	5-ton	Pneumatic hoists	Manning, Maxwell & Moore
2		Pneumatic hoists	Ingersoll-Rand Co.
2		Electric traveling cranes	Manning, Maxwell & Moore
2	10-ton	Cranes	Euclid Crane & Hoist Co.
1		Crane	Manning, Maxwell & Moore
1		Crane and hoist	Shepard Elec. Crane & Hoist Co.
2	220-volt	D. C. motors	U. S. Light & Heat Corp.
2	7½-kw.	Motor generators	Westinghouse Electric & Mfg. Co.
4	300-amp.	Welders	U. S. Light & Heat Corp.
2		Valve setting machines	Morgan Engineering Co.
1	50,000-lb.	Vertical test machine	Riehle Bros. Testing Mach. Co.

Mobile & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 9-ft.	Engine lathe	Lehman Machine Co.
1	18-in. by 10-ft.	Engine lathe	Cisco Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Monarch Machine Tool Co.
1	18-in. by 11-ft.	Engine lathe	Lehman Machine Co.
1	20-in. by 6-ft. 6-in.	Engine lathe	Dresses Machine Tool Co.
4	20-in. by 10-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
1	20-in. by 11-ft.	Engine lathe	Lehman Machine Co.
1	20-in. by 12-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	20-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 13-ft.	Engine lathe	Lehman Machine Co.
1	24-in. by 14-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	30-in. by 14-ft.	Lathe	Boye & Emmes Machine Tool Co.
1	42-in. by 18-ft.	Putnam engine lathe	Manning, Maxwell & Moore
1	90-in.	Putnam wheel lathe	Manning, Maxwell & Moore
1	90-in.	Lathe	Niles-Bement-Pond Co.
1		Car wheel lathe	Niles-Bement-Pond Co.
1	36-in.	Turret lathe	International Machine Tool Co.
1	3-in. by 36-in.	Turret lathe	Jones & Lamson Machine Co.
1	3½-in. by 44-in.	Turret lathe	Acme Machine Tool Co.
1		Turret lathe	Warner & Swasey Co.
1	2½-ft.	Radial drill	Dresses Machine Tool Co.
2	5-ft.	Radial drills	American Tool Works
1		Radial drill	Barnes Drill Co.
1	34-in.	Upright drill	W. F. & J. Barnes Co.
1	36-in.	Upright drill	Foote-Burt Co.
1	2-spindle	Sensitive drilling machine	Francis Reed Co.
1	4-in.	Centering machine	Pratt & Whitney Co.
1		Staybolt drilling machine	Taylor & Fenn Co.
1	36-in. by 36-in. by 12-ft.	Planer	G. A. Gray Co.
1	36-in. by 36-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 18-ft.	Planer	Niles-Bement-Pond Co.
2	32-in.	Shapers	Cincinnati Shaper Co.
1	32-in.	Draw cut pillar shaper	Morton Manufacturing Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	24-in.	Newton crank slotting machine	Consolidated Machine Tool Corp.
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	36-in. by 44-in.	Boring mill	Niles-Bement-Pond Co.
1		Boring and turning mill	Gisholt Machine Co.
1	30-in. by 24-in. by 10-ft.	Milling machine	Ingersoll Milling Machine Co.
2		Milling machines	Cincinnati Milling Machine Co.
1	18-ft. by 30-in. by 96-in.	Gap grinder	Norton Co.
1		Internal and link grinder	Gisholt Machine Co.
3		Floor grinders	J. G. Blount Co.
2		Floor grinders	U. S. Electrical Tool Co.
1	5-hp.	Motor grinder	J. G. Blount Co.

Missouri-Kansas-Texas

No.	Size and capacity	Type of machine	Builder or dealer
2		**Putnam double axle lathes**	**Manning, Maxwell & Moore**
1		**Helical ball bearing lathe**	**Manning, Maxwell & Moore**
1		**Pearce journal truing machine**	W. C. Dunn Co.
1	20-in.	Cincinnati-Bickford upright drill	Elliott & Stephens Co.
1	No. 64	Staybolt drilling machine	Taylor & Fenn Co.
1		Drawcut shaper	Morton Manufacturing Co.
1	Type 5 WFA	Double end emery grinder	Hisey-Wolf Machine Co.
1	Type 7 WFA	Floor grinder	Hisey-Wolf Machine Co.
1	2-wheel	Ball bearing floor grinder	Hisey-Wolf Machine Co.
1		Tool grinding and shaping machine	Wm. Sellers & Co., Inc.
1	No. 15	Pattern maker's tool grinder	Chas. H. Besley & Co.
1	No. 3-A	Arbor press	Blackman-Hill-McKee Co.
2	No. 10	Multiple punching machines	Beatty Machine & Mfg. Co.
1	No. 112-M	Rotary shear	Marshaltown Manufacturing Co.
1	113-ft.	Spacing table	Beatty Machine & Mfg. Co.
1	3-in. to 4-in.	Flanging machine	McCabe Manufacturing Co.
3	No. 0	Forge blowers	Buffalo Forge Co.
2	No. 1	Forge blowers	Buffalo Forge Co.
1	No. 9	Sturtevant forge blower	Buffalo Forge Co.
2	No. 502	Forge blowers	Mahr Manufacturing Co.
2	No. 502	Forge blowers	Buffalo Forge Co.
1	1,200-cu. ft.	Forge blower	Johnston Manufacturing Co.
1	No. 45A	Annealing furnace	DeRemer-Blatchford Co.
1	5-ton	Traveling crane	Whiting Corp.
1	20-ton	Traveling crane	Whiting Corp.
5	1½-ton	Electric hoists	Shepard Elec. Crane & Hoist Co.
5	2-ton	Jib cranes	Stupp Bros. Bridge & Iron Co.
2		Universal valve test racks	New York Air Brake Co.
1	3-T	Valve test rack	New York Air Brake Co.
2		Arc welding motor generator sets	General Electric Co.
1	200-amp.	Electric welder	U. S. Light & Heat Corp.
2	300-amp.	Electric welders	U. S. Light & Heat Corp.
1	300-amp.	Electric welder	Lincoln Electric Co.
1		Arc welding machine	Lincoln Electric Co.

Missouri Pacific

No.	Size and capacity	Type of machine	Builder or dealer
2		Axle lathes	Consolidated Machine Tool Corp.
1	18-in. by 9-ft.	Lehman bed lathe	Colcord-Wright Mach. & Supply Co.
2	18-in. by 11-ft	Engine lathes	Colcord-Wright Mach. & Supply Co.
3	19-in. by 10-ft.	Engine lathes	Niles-Bement-Pond Co.
2	27-in.	Engine lathes	American Tool Works
2		LeBlond engine lathes	Niles-Bement-Pond Co.
1		Engine lathe	R. K. LeBlond Machine Tool Co.
1		Pratt & Whitney tool lathe	Niles-Bement-Pond Co.
2	3-in. by 36-in.	Turret lathe	Jones & Lamson Machine Co.
2	90-in.	Wheel lathe	Wm. Sellers & Co., Inc.
1		Engine lathe	Lodge & Shipley Machine Tool Co.
2	3-ft.	Radial drill	American Tool Works
1	3-ft.	Triple radial drill	American Tool Works
1	42-in.	Vertical drill	Manning, Maxwell & Moore
1	42-in.	Vertical drill	Consolidated Machine Tool Corp.
8	No. 20	Stanley sensitive drills	Francis Reed Co.
3	32-in.	Shapers	Gould & Eberhardt
3	32-in.	Crank shapers	Gould & Eberhardt
1		Shaper	Gould & Eberhardt
1	No. 31	Boring and drilling machine	Lucas Machine Tool Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
1	84-in.	Betts tire mill	Consolidated Machine Tool Corp.
1		Car wheel lathe	Wm. Sellers & Co., Inc.
1	No. 513	Boring drill	Baker Brothers
1		Boring and facing machine	Baker Brothers
1	No. 5	Milling machine	Cincinnati Milling Machine Co.
1		Newton milling machine	Consolidated Machine Tool Corp.
1		Milling machine	Ingersoll Milling Machine Co.
1		Die sinking machine	Pratt & Whitney Co.
1	12-in. by 48-in.	Grinding machine	Cincinnati Milling Machine Co.
1	No. 3	Grinder	Cincinnati Milling Machine Co.
1	3-in. by 24-in.	Double end grinder	Manning, Maxwell & Moore
2	No. 7	Floor grinders	Hisey-Wolf Machine Co.
1		Chaser grinder	Geometric Tool Co.
4		Grinders	Manning, Maxwell & Moore
1		Grinder	Diamond Machine Co.
1		Cylinder boring bar	H. B. Underwood Corp.
5	2-in.	Threading machines	Landis Machine Co.
2		Oster pipe threading machines	Hendrie & Bolthoff Mfg. & Sup. Co.
1	50-ton	Bushing press	Niles-Bement-Pond Co.
1	100-ton	Bushing press	Niles-Bement-Pond Co.
1	1,100-lb.	Steam hammer	Niles-Bement-Pond Co.
2	5-hp.	Floor grinders	U. S. Electrical Tool Co.
1	18-in. by 3-in.	Dry grinding machine	Ransom Manufacturing Co.
1	6-spindle	Valve grinder	Automatic Valve Grind. Mach. Co.
1		Dry drill grinder	Grand Rapids Grinding Mach. Co.
2		Grindstones	Handlan-Buck Manufacturing Co.
1	3¼-in. by 7-ft.	Boring bar	H. B. Underwood Corp.
1	1½-in.	Bolt threading machine	Landis Machine Co.
1	2½-in.	Bolt threading machine	Landis Machine Co.
1		Bolt cutter	Landis Machine Co.
1		Pipe threading and cutting machine	Oster Manufacturing Co.
1		Pipe bending machine	H. B. Underwood Corp.
2	100-ton	Hydraulic bushing presses	Niles-Bement-Pond Co.
1	800-ton	Hydraulic wheel press	R. D. Wood & Co.
1	200-lb.	Strap hammer	C. C. Bradley & Son, Inc.
1	500-lb.	Upright helve hammer	C. C. Bradley & Son, Inc.
1	3,400-lb.	Steam hammer	Chambersburg Engineering Co.
1	3½-in.	Forging machine	Ajax Manufacturing Co.
1		Punching machine	Cleveland Punch & Shear Works
1		Shearing machine	Cleveland Punch & Shear Works
1		Shear and punch	Peck, Stow & Wilcox Co.
1		Electric flue welder	Thompson Electric Welding Co.
1		Flue cleaning machine	Jos. T. Ryerson & Son.
1		Pneumatic flanging machine	McCabe Manufacturing Co.
1		Bending roll	Niles-Bement-Pond Co.
1		Crimping and bending machine	Peck, Stow & Wilcox Co.
1		Bending brake	Dreis & Krump Manufacturing Co.
17		Electric blowers	Buffalo Forge Co.
1		Exhaust fan	Buffalo Forge Co.
12		Blacksmith forges	Buffalo Forge Co.
1		Blacksmith forge	Johnston Manufacturing Co.
1		Babbitt furnace	DeRemer-Blatchford Co.
2		Forging furnaces	DeRemer-Blatchford Co.
1	54-in.	Case hardening furnace	DeRemer-Blatchford Co.
1	4-ft. by 15-ft.	Annealing furnace	DeRemer-Blatchford Co.
1	5-ft. by 7-ft. 6-in.	Hammer furnace	DeRemer-Blatchford Co.
1	5-spindle	Vertical radial car borer	Greenlee Brothers & Co.
1		Timber sizer, planer and matcher	P. B. Yates Machine Co.
1		Cut-off saw	J. A. Fay & Egan Co.
1		Rip saw	J. A. Fay & Egan Co.
1	36-in.	Band saw	P. B. Yates Machine Co.
1		Electric crane truck	Elwell-Parker Electric Co.
1		Electric elevating platform truck	Baker R. & L. Co.
12	2-ton	Yard trailer cars	St. Louis Truck & Mfg. Co.
1		Brownie tractor	Fill Motor & Tractor Co.
2		Electric welding machines	Big Three Welding & Equip. Co.

Nashville, Chattanooga & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in. by 10-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
2	No. 2-A	Warner & Swasey turret lathes	James Supply Co.
1	15-in.	Barnes sensitive drill press	Manning, Maxwell & Moore
1	No. 2	Rod and dowel machine	W. S. Hawker Manufacturing Co.
1		Staybolt turning & threading mach.	Walter H. Foster Co.
1	600-ton	Hydraulic wheel press	Niles-Bement-Pond Co.
1	Type E	Bolt and rod straightener and shear	C. E. McArthur & Co.
1	Size H	Hilles & Jones punch and shear	E. A. Kinsey Co.
1	15-ton	Electric crane	Shepard Elec. Crane & Hoist Co.
1	1½-ton	Electric crane truck	Elwell-Parker Electric Co.
1		Industrial tractor with six trailers	W. F. Hebard & Co.
1	150-amp.	Electric arc welder	Lincoln Electric Co.
1	150-amp.	Electric arc welder	Westinghouse Electric & Mfg. Co.

New Orleans Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	1,250-lb.	Steam hammer	Chambersburg Engineering Co.
1		Welding and cutting outfit	Torchweld Equipment Co.
1		Automatic carbide generator	Imperial Brass Mfg. Co.

New York Central

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal turning lathe	Niles-Bement-Pond Co.
1		Axle lathe	Consolidated Machine Tool Corp.
3		Double end axle lathes	Niles-Bement-Pond Co.
1		Betts double end axle lathe	Consolidated Machine Tool Corp.
2	17-in.	Engine lathes	Manning, Maxwell & Moore
2	18-in.	Engine lathes	Niles-Bement-Pond Co.
2	21-in.	Engine lathes	Niles-Bement-Pond Co.
1	22-in.	Gap lathe	Niles-Bement-Pond Co.
2	25-in.	Gap lathes	Niles-Bement-Pond Co.
1	1½-in.	Turret lathe	Warner & Swasey Co.
2	2¼-in.	Turret lathes	Jones & Lamson Machine Co.
1	3-in.	Turret lathe	Jones & Lamson Machine Co.

New York Central (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
2	6-ft.	Radial drill presses	Manning, Maxwell & Moore
1	6-ft.	Radial drill press	Niles-Bement-Pond Co.
1	14-in.	Upright drill press	Chas. G. Allen Co.
3	26-in.	Upright drill presses	Niles-Bement-Pond Co.
1	¼-in. to 5⅛-in.	Centering machine	Manning, Maxwell & Moore
1	½-in. to 6-in.	Centering machine	Manning, Maxwell & Moore
1	2½-in. to 4-in.	Centering machine	Niles-Bement-Pond Co.
3	24-in.	Shapers	Jos. T. Ryerson & Son
4	32-in.	Shapers	Manning, Maxwell & Moore
1	24-in.	Boring mill	Bullard Machine Tool Co.
1	44-in.	Boring mill	Niles-Bement-Pond Co.
1	44-in.	Boring mill	Manning, Maxwell & Moore
1	48-in.	Boring mill	Wm. Sellers & Co., Inc.
1	54-in.	Boring mill	Wm. Sellers & Co., Inc.
1	100-in.	Boring mill	Consolidated Machine Tool Corp.
1		Boring mill	Landis Machine Co.
1	No. 3	Milling machine	Cincinnati Milling Machine Co.
1	No. 5	Cincinnati milling machine	Henry Prentiss & Co.
2		Horizontal slab milling machines	Ingersoll Milling Machine Co.
1		Milling machine	Ingersoll Milling Machine Co.
1	No. 3	Key seating machine	Niles-Bement-Pond Co.
1	No. 13	Tool and surface grinder	Brown & Sharpe Mfg. Co.
1		Vertical surface grinder	Henry Prentiss & Co.
1	6-in.	Floor grinder	U. S. Electrical Tool Co.
1	12-in.	Floor grinder	Cincinnati Electrical Tool Co.
1	16-in.	Electric grinder	U. S. Electrical Tool Co.
1		Double grinder	Henry Prentiss & Co.
1		Double grinder	Ransom Manufacturing Co.
2		Double grinders	Niles-Bement-Pond Co.
1	10⅝-in. by 22-in.	Cutter and tool grinder	Wilmarth Morman Co.
1		Die sharpener	Niles-Bement-Pond Co.
1	4-in. by 24-in.	Knife grinder	Manning, Maxwell & Moore
1	1-hp.	U. S. bench buffer	Henry Prentiss & Co.
1	8-in. by 8-in.	Hack saw	Peerless Machine Co.
3		Cylinder boring bars	Manning, Maxwell & Moore
1		2-cylinder facing machine	Manning, Maxwell & Moore
1	2-in.	Bolt cutter	Landis Machine Co.
1	2-in.	Pipe threading machine	Landis Machine Co.
1	4-in.	Pipe threader	Landis Machine Co.
1	15-ton	Broaching and forging press	Manning, Maxwell & Moore
4	50-ton	Bushing presses	Manning, Maxwell & Moore
1	100-ton	Bushing press	Manning, Maxwell & Moore
1	800-ton	Wheel press	R. D. Woods & Co.
1	3,500-lb.	Steam hammer	Erie Foundry Co.
1	⅛-in. by 48-in.	Power squaring shear	Niagara Machine & Tool Works
1	3/16-in.	Nibbling machine	A. C. Campbell Co.
1	1-B	Nibbling machine	A. C. Campbell Co.
1		Punch and shear	Consolidated Machine Tool Corp.
1	3-in. by 42-in.	Slip roll	Niagara Machine & Tool Works
1	42-in.	Keystone bar folder	Niagara Machine & Tool Works
1	8-ft.	Cornice brake	Niagara Machine & Tool Works
1	10-in.	Buffalo edging machine	Niagara Machine & Tool Works
1		Superior small burr	Niagara Machine & Tool Works
1		Superior large burr	Niagara Machine & Tool Works
1		Superior small turner	Niagara Machine & Tool Works
1		Superior large turner	Niagara Machine & Tool Works
1	No. 02½	Beading machine	Niagara Machine & Tool Works
1	No. 1	Beading machine	Niagara Machine & Tool Works
1		Automatic soot blower	Vincent Gilson Co.
1		Automatic soot blower	Bayer Co.
1		Oil furnace	DeRemer-Blatchford Co.
4		Electric rivet heaters	Humil Corporation
2	4-ft. by 14-ft.	Annealing furnaces	DeRemer-Blatchford Co.
1	No. 4	Soldering gas furnace	Equipment Mfg. & Supply Co.
1		Cut-off saw and table	Oliver Machinery Co.
1	15-hp.	Rip saw	Greenlee Bros. & Co.
1	No. 405	Rip saw	J. A. Fay & Egan Co.
1	No. 500	Variety saw	J. A. Fay & Egan Co.
2	30-in.	Single cylinder surfacers	P. B. Yates Machine Tool Co.
1	No. 369	Planing, matching & molding mach.	J. A. Fay & Egan Co.
1	20-in.	Hand jointer	J. A. Fay & Egan Co.
1		Air motor hoist	Ingersoll-Rand Co.
2		Air brake test racks	Westinghouse Air Brake Co.
2	216-cu. ft.	Air compressors	Ingersoll-Rand Co.
1	1,200-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	2,440-lb.	Electric crane truck	Elwell-Parker Electric Co.
4	3,000-lb.	Electric trucks	Elwell-Parker Electric Co.
1	4,000-lb.	Electric lift truck	Elwell-Parker Electric Co.
1		Universal cutter and tool grinder	Wilmarth-Morman Co.
1		Chaser grinder	Landis Machine Co.
1	⅛-in. to 3-in.	Automatic drill pointer	Oliver Instrument Co.
1		Die sinking grinder	Keller Mech. Engineering Corp.
1	3½-in. by 6-ft.	Boring bar	H. B. Underwood Corp.
1	6-in. by 8-ft.	Boring bar	H. B. Underwood Corp.
2	¼-in. to 2-in.	Pipe threading and cutting mach.	Oster Manufacturing Co.
1	½-in. to 8-in.	Pipe threading machine	Toledo Pipe Threading Machine Co.
1	50-ton	Power forcing press	Lucas Machine Tool Co.
1	48-in.	Trimming press	E. W. Bliss Co.
1	4,000-lb.	Drop hammer	Erie Foundry Co.
1	⅛-in.	Rotary shear	Marshalltown Manufacturing Co.
1	¼-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
1	2¼-in.	Bar machine	Cleveland Automatic Machine Co.
1	4½-in.	Bar machine	Cleveland Automatic Machine Co.
1	8-in. by 12-in. by 22-in.	Electric furnace	Westinghouse Electric & Mfg. Co.
1	8-in. by 12-in. by 28-in.	Hearth furnace	Westinghouse Electric & Mfg. Co.
1	2-ton	Electric hoist	Shepard Electric Crane & Hoist Co.
1	10-ton	Traveling crane	Niles-Bement-Pond Co.
1	800-lb.	Electric tractor	Baker R. & L. Co.
1	3,000-lb.	Electric crane truck	Baker R. & L. Co.
3	30-cu. ft.	Tructractors	Clark Tructractor Co.
3	46-in. by 124-in.	Tructractors	Clark Tructractor Co.
2	1,500-lb.	Tructractors	Clark Tructractor Co.
10	3-ton	Platform trailers	Lakewood Engineering Co.
28	4-ton	Platform trailers	Mercury Mfg. Co.
10	5-ton	Platform trailers	Lakewood Engineering Co.
15	1-yd.	Side dump trailers	Mercury Manufacturing Co.

Oregon Short Line

No.	Size and capacity	Type of machine	Builder or dealer
1	5-ft.	Radial drill	American Tool Works
1	44-in.	Boring and turning mill	Manning, Maxwell & Moore
1	No. 10	Trimming press	Erie Foundry Co.
1	1,500-lb.	Steam drop hammer	Niles-Bement-Pond Co.
1	1½-in. to 3-in.	Flue cutting-off machine	Jos. T. Ryerson & Son

Oregon-Washington Railroad & Navigation Co.

No.	Size and capacity	Type of machine	Builder or dealer
3	No. 29	Drill presses	Canedy-Otto Mfg. Co.
1		Electric grinder	Stand & Co.
1	36-in.	Power gap shear	Kutscheid Manufacturing Co.
1	5-ft. 10-in. by 16-ft. 6-in.	Annealing furnace	DeRemer-Blatchford Co.
1	12-in. by 8-in. by 33-in.	Electric furnace	Hoskins Manufacturing Co.

Pacific Fruit Express

No.	Size and capacity	Type of machine	Builder or dealer
1	26-in.	Aurora drill	Niles-Bement-Pond Co.
1	36-in. by 4½-in.	Grindstone	Cleveland Stone Co.
1	No. 130	Grinding machine	Ransom Manufacturing Co.
1	1½-in.	Bolt threading machine	Landis Machine Co.
1	No. 2	Power hammer	Nazel Engineering & Mach. Works
1	No. 21	Punch and shear	Henry Pels & Co.
2	No. 86	Forges	Buffalo Forge Co.
1	No. 503	Pressure blower	Mahr Manufacturing Co.
1	10-in.	Four-sided molder	American Woodwk. Machinery Co.
1	24-in.	Swing saw	American Woodwk. Machinery Co.
1	36-in.	Band saw	American Woodwk. Machinery Co.
1	36-in. by 44-in.	Variety saw	American Woodwk. Machinery Co.
1	Model 3-T	Triple valve test rack	New York Air Brake Co.

Panhandle & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
1	2-in.	Double head bolt cutter	Marshall & Huschart Mchy. Corp.
1		Portable crank pin press	Watson-Stillman Co.
1	3-hp.	Induction motor	General Electric Co.

Pennsylvania System

No.	Size and capacity	Type of machine	Builder or dealer
1		Journal truing lathe	
4		Engine lathes	
4		Turret lathes	
1		Car wheel lathe	
1		Lathe and boring machine	
1		Automatic screw machine	
3		Radial drills	
2		Drill presses	
1		Sensitive drill	
2		High duty drills	

No.	Size and capacity	Type of machine	Builder or dealer
1		Electric crane truck	Elwell-Parker Electric Co.
1		Tractor and snow sweeper	Ford Motor Co.
1	1½-hp.	Motor for drill press	General Electric Co.
1	2-hp.	Motor	General Electric Co.
1	3-hp.	Motor	General Electric Co.
1	10-hp.	Motor	General Electric Co.
1	30-hp.	Motor	R. D. Woods & Co.
	10-kw.	Generator set	Wooten Co.
1		Motor generator set	S. Pitman Electric Corp.
1	12.5-kw.	Battery charging plant	Electric Products Co.
1	550-volt	Welder	Electric Arc Cutting & Welding Co.
1		Automatic welder and generator	S. Pitman Electric Corp.
1		Electric welder	C. & C. Electric Mfg. Co.
4	48-in.	Half-round iron horses	Railway Devices Co.
1	4-ft. 3-in. by 5-ft. ½-in. by 29-in.	Metal cleaning machine	Crescent Washing Machine Co.
1	235-cu. ft.	Aftercooler	Ingersoll-Rand Co.
1	560-cu. ft.	Aftercooler	Ingersoll-Rand Co.
1	4-ft. 5-in. by 12-ft. 1½-in. by 2-ft.	Adjusting machine	Walter Stock Adjusting Mach. Co.

New York, Chicago & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	90-in.	Journal lathe	Niles-Bement-Pond Co.
1	2½-in.	Turret lathe	Warner & Swasey Co.
1	5-ft.	Radial drill press	American Tool Works
1	36-in. to 44-in.	Side head boring mill	Niles-Bement-Pond Co.
1	2-in. by 14-in.	Electric floor grinder	Hisey-Wolf Machine Co.
1	3-in. by 18-in.	Electric floor grinders	Hisey-Wolf Machine Co.
1	No. 1	Racine hack saw	Niles-Bement-Pond Co.
1	1½-in.	Staybolt cutter	Landis Machine Co.
1	2-in.	Pipe machine	Bignall & Keller Mfg. Works
1	600-ton	Driving wheel press	Chambersburg Engineering Co.
1		Punch and shear	Cleveland Punch & Shear Works
1	36-in.	Self-feed rip saw	Greenlee Bros. & Co.
1	6-ft. by 8-ft.	Oil forging furnace	Ferguson Furnace Co.
1	300-amp.	Electric welder	Lincoln Electric Co.

New York, New Haven & Hartford

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in.	Engine lathe	Manning, Maxwell & Moore
1	6-ft.	Radial drill	Carlton Machine Tool Co.
1	6-ft.	Radial drill	American Tool Works
1		Rail drilling machine	Crerar-Adams & Co.
1	32-in.	Shaper	Gould & Eberhardt
1	44-in.	Driving box borer and facer	Bullard Machine Tool Co.
1	90-in.	Vertical boring and turning mill	King Machine Tool Co.
1	6-in. by 6-in.	Hack saw	Peerless Machine Co.
1	No. 0	Locomotive cylinder facing mach.	H. B. Underwood Corp.
1	No. 1	Locomotive cylinder facing mach.	H. B. Underwood Corp.
2	No. 2	Locomotive cylinder facing mach's.	H. B. Underwood Corp.
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	30-in. by 12-in.	Single surfacer	American Woodwk. Machinery Co.
1	No. C-85	Wood working machine	Brackett, Shaw & Co.
1	40-in.	Hand feed bevel band saw	American Woodwk. Machinery Co.
1	36-in.	Rip saw machine	Greenlee Bros. & Co.
1	36-in.	Cut-off saw	Greenlee Bros. & Co.
1	2-ton	Gantry crane	Bradney Machine Co.

Norfolk & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
1	18-in. by 10-ft.	Engine lathe	Bradford Machine Tool Co.
1	27-in. by 16-ft.	Engine lathe	Niles-Bement-Pond Co.
4	20-in.	Lathes	Dresses Machine Tool Co.
1	100-per hr.	Journal bearing broaching machine	Morton Manufacturing Co.
1	5¾-in. spindle	Auto. chucking machine	Potter & Johnston Machine Co.
2	⅞-in.	High speed drilling machines	Avery Drilling Machine Co.
4	16-in.	Sensitive drills	Fosdick Machine Tool Co.
1	42-in. by 24-in. by 14-ft.	Planer	G. A. Gray Co.
1	24-in.	Crank shaper	Columbia Machine Tool Co.
1	32-in.	Shaper	Cincinnati Shaper Co.
1	42-in.	Vertical boring mill	Bullard Machine Tool Co.
1	50-in.	Vertical milling machine	Niles-Bement-Pond Co.
1	1⅝-in. to 15-in. dia. to 16-in. deep	Internal grinder	Micro Machine Co.
1	20-in. by 68-in.	Internal grinder	Micro Machine Co.
1	30-in. by 108-in.	Grinder	Diamond Machine Co.
1	12-in. by 36-in.	Grinding machine	Fitchburg Grinding Machine Co.
1		Universal tool and cutter grinder	R. K. LeBlond Machine Tool Co.

No.	Size and capacity	Type of machine	Builder or dealer
1		Close quarter drill	
1		Bolt centering machine	
1		Crank planer	
2		Horizontal boring & turning mach.	
2		Horizontal boring & drilling mach.	
1		Vertical boring mill	
1		Boring mill	
6		Milling machines	
1		Link grinding machine	
2		Tool grinders	
3		Wet tool grinders	
4		Grinding machines	
1		Double motor driven grinder	
1		Angle cock grinding machine	
2		Hack saws	
6		Portable head and dome facing machines	
1		Horizontal boring and facing mach	
2		Bolt threaders	
1		Air hose nipple threader	
2		Pipe cutting & threading machines	
1		Pipe bending machine	
1		Turning and threading machine	
1		Bolt pointing machine	
1		Nut tapper	
1		Hydraulic wheel press	
2		Bushing presses	
1		Twin straightening press	
1		Brake beam straightening press	
1		Straightening press and furnace	
1		Coupler straightening press	
1		Steam hammer	
1		Bolt straightening hammer	
1		Rotary splitting shear	
1		Straightener and shear	
1		Double end punch and shear	
1		Punch and shear	
1		Flue safe end welding mach.	
1		Safe end cutter and scarfer	
1		Flue mill	
1		Swedging machine	
1		Planer and matching machine	
2		Rip saws	
1		Wood saw	
1		Electric traveling crane	
3		Cranes	
85		Jib cranes and hoists	
1		Gasoline crane	
18		Shop trucks	
11		Electric welding outfits	

Peoria & Eastern

No.	Size and capacity	Type of machine	Builder or dealer
1	25-in.	Upright drill press	Weigel Machine Tool Co.
1	42-in.	Vertical boring & turning machine	King Machine Tool Co.
1	1½-in.	Double head bolt cutter	Landis Tool Co.
1	784-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	200-amp.	Arc welding equipment	Westinghouse Electric & Mfg. Co.

Pere Marquette

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in. by 6-in.	Double surfacer	P. B. Yates Machine Co.
1	12-in. by 8-in.	Four-side molder	P. B. Yates Machine Co.
1	24-in.	Hand jointer	Oliver Machinery Co.
1	No. 16	Ball bearing belt sander	American Woodwk. Machinery Co.

Pittsburgh & Lake Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	1½-in	Single head threading machine	Landis Machine Co.
1	4-in. round, 3¼-in. square	Alligator shear	Doelger & Kirsten Co.
1	50-ton	Drop pit jack	Whiting Corp.
1	10-ton	Electric traveling crane	Manning, Maxwell & Moore
1	25-ton	Locomotive crane	Ohio Locomotive Crane Co.
3	3,000-lb.	Electric crane trucks	Elwell-Parker Electric Co.

Pittsburgh & Shawmut

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in.	Wet tool grinder	J. G. Blount Co.
1	No. 2	Rivet forge	Mead-Morrison Mfg. Co.

Pittsburgh, Shawmut & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1		Air compressor	Ingersoll-Rand Co.

Public Belt R. R. of New Orleans

1	80-in.	Driving wheel lathe	Manning, Maxwell & Moore
1	21-in.	LeBlond lathe	Oliver H. Van Horn Co.
1	36-in.	Lathe	Manning, Maxwell & Moore
1	2-in.	Landis bolt threading machine	Woodward, Wight & Co.
1	1,100-lb.	Forging hammer	Manning, Maxwell & More
1	Size E	Hilles & Jones punch and shear	C. T. Patterson Co.
1		Locomotive hoist	Whiting Corp.
1	70-in.	Locomotive crane	Baker R. & L. Co.
1	8,000-lb.	Electric Hoist	Shepard Electric Crane & Hoist Co.

Reading Co.

1	90-in.	Driving wheel lathe	Wm. Sellers & Co., Inc.
1	32-in.	Shaper	Gould & Eberhardt
1	32-in.	Shaper	Columbia Machine Tool Co.
1	No. 425	Drilling and boring machine	Baker Brothers
1	1-in. to 4-in.	Pipe thread. and cutting-off mach.	Oster Manufacturing Co.
1	600-ton	Hydraulic wheel press	Watson-Stillman Co.
1	5,000-lb.	Electric hoist	Roeper Crane & Hoist Co.
1	1,500-lb.	Electric crane truck	Crescent Truck Co.
13	4,000-lb.	Electric platform trucks	Crescent Truck Co.

Richmond, Fredericksburg & Potomac

1	20-in.	Engine lathe	American Tool Works
1		Car axle lathe	Manning, Maxwell & Moore
1	3½-ft.	Radial drill press	American Tool Works
1	24-in.	Upright drill press	Foote-Burt Co.
1	48-in.	Car wheel boring mill	Manning, Maxwell & Moore
1	No. 2	Drill grinder	Wm. Sellers & Co., Inc.
1		Die sharpener	National Machinery Co.
1	500-ton	Car wheel press	Chambersburg Engineering Co.
1	1,500-lb.	Steam hammer	Chambersburg Engineering Co.
1	No. 351	Wood borer	Greenlee Bros. & Co.
1	No. 3	Scroll saw	J. A. Fay & Egan Co.
1	20-in.	Joiner	C. O. Porter Machinery Co.
1	No. 8	Saw and dado machine	American Woodwk. Machinery Co.
1	No. 70	Tenoning machine	J. A. Fay & Egan Co.
2	25-ton	Car jacks	Whiting Corp.
1	600-cu. ft	Air compressor	Chicago Pneumatic Tool Co.

St. Joseph & Grand Island

1	Type KRE-2	Air compressor	Ingersoll-Rand Co.
1	220-amp.	Arc welding machine	Westinghouse Electric & Mfg. Co.

St. Louis-San Francisco

1		Double head axle lathe	
1	16-in. by 8-ft.	Toolroom lathe	
1	5-ft.	Radial drill press	
1	32-in.	Shaper	
1	42-in.	Switch and frog planer	
1		Planer	
1		Driving box boring mill	
2		Internal grinders	Heald Machine Co.
1		Drill grinder	Oliver Machinery Co.
1		Grinding machine	
1	No. 3	Hacksaw	
1		Boring bar	
3	150-ton	Vertical bushing presses	
1		Elliptic spring forming machine	
1	2,000-lb.	Steam hammer	
1		Slitting shears	
1		Band saw	

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 2	Electric forge blower	Champion Blower & Forge Co.
1		Electric forge blower	Buffalo Forge Co.
1	10-ton	Traveling crane	Niles-Bement-Pond Co.
1	8-ton	Hoist	American Engineering Co.
1	30-ton	Gantry crane	Manning, Maxwell & Moore
1	200-amp.	Welding generator	U. S. Light & Heat Corp.

Spokane, Portland & Seattle

1	24-in.	Upright drill press	Superior Machine Tool Co.

Terminal Railroad Association of St. Louis

1	14-in.	Internal and link grinder	Gisholt Machine Co.
1	100-lb.	Power hammer	Beaudry & Co.
1	1-in. by 8-in.	Hand bending machine	Kerlin Co.
1	200-amp.	Arc welder	General Electric Co.

Toledo Terminal

1	36-in. to 44-in.	Boring mill	Niles-Bement-Pond Co.

Texas & Pacific

1	5-ft.	Radial drill press	Niles-Bement-Pond Co.
1	32-in.	Upright drill	Niles-Bement-Pond Co.
1	20-in. by 20½-in.	Wet tool grinder	Niles-Bement-Pond Co.
1	No. 206	Floor grinder	Hisey-Wolf Machine Co.
1	200-lb.	Helve hammer	Manning, Maxwell & Moore
1	No. 7	Flanging machine	McCabe Manufacturing Co.
1	20-in. by 2-in.	Eight-roll boss timber dresser	American Woodwk. Machinery Co.

Union Pacific

2	No. 3	Axle lathes	Niles-Bement-Pond Co.
1	18-in. by 8-ft.	Engine lathe	Monarch Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	24-in. by 14-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	55-in.	Betts truing lathe	Consolidated Machine Tool Corp.
1	1⅞-in.	Screw machine	Manning, Maxwell & Moore
1	2-ft.	Radial drill	American Tool Works
1	5-ft.	Radial drill	Dresses Machine Tool Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	No. 17	Two spindle drill	Foote-Burt Co.
1	32-in.	Newton planer	Consolidated Machine Tool Corp.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	18-in.	Slotting machine	Manning, Maxwell & Moore
1	48-in.	Boring mill	Niles-Bement-Pond Co.
1	No. 2A	Milling machine	Brown & Sharpe Mfg. Co.
1	25-hp.	Rotary milling machine	Ingersoll Milling Machine Co.
1	18-in. to 100-in.	Radius grinder	Rockford Tool Co.
2	18-in.	Grinders	Micro Machine Co.
1	No. 1	Die sharpener	National Machinery Co.
1	5 WFA	Floor grinder	Hisey-Wolf Machine Co.
1	No. 8	Little David pedestal grinder	Fuchs Equipment Co.
1	3/32-in. to 4-in.	Drill grinder	
1	¼-in. to 2-in.	Pipe threading machine	Oster Manufacturing Co.
1	250-ton	Car wheel press	Chambersburg Engineering Co.
1	300-ton	Press	Chambersburg Engineering Co.
1	No. 22	Eye bolt machine	Williams, White & Co.
2	No. 1½	Punch and shears	Long & Allstatter Co.
1	52-in.	Foot gap shear	Niagara Machine & Tool Works
1	Up to 6-in.	Flue welder	Thomson Electric Welding Co.
1	12-ft.	Flanging clamp	Niles-Bement-Pond Co.
1	No. 4	Forming machine	Jos. T. Ryerson & Son
1	8-ft. 1-in.	Brake	Dreis & Krump Mfg. Co.
2	No. 4	Electric rivet heaters	American Car & Foundry Co.
1	12-in. by 8-in. by 26-in.	Furnace	Hoskins Manufacturing Co.
1	18-in.	Cut-off saw	J. A. Fay & Egan Co.
1	21-in.	Cut-off saw	J. A. Fay & Egan Co.
1	21½-in by 4¼-in.	Rip saw	J. A. Fay & Egan Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	8-ton	Hoist	Pawling & Harnischfeger Co.

4	3-T	A.R.A. triple valve test racks	
2	1,500-cu. ft.	Air compressors	
10		Electric welding machines	

St. Louis-Southwestern

No.	Size and capacity	Type of machine	Builder or dealer
1	20-40-in. by 10-ft.	Bed gap lathe	Rahn-Larmon Co.
1	3-ft.	Radial drill	Dresses Machine Tool Co.
1	34-in.	Upright drill	W. F. & J. Barnes Co.
1	14-in.	Sensitive floor drill	U. S. Machine Tool Co.
1	20-in.	Shaper	Gould & Eberhardt
1	No. 5	Milling machine	Cincinnati Milling Machine Co.
1	No. 3 BXA	Combination grinder	Hisey-Wolf Machine Co.
1	No. 6 WFA	Double emery wheel grinder	Hisey-Wolf Machine Co.
1	Type M	Parallel grinder	U. S. Electric Co.
1		Chaser grinder	Landis Machine Co.
1	12-in.	Crank pin turning machine	H. B. Underwood Corp.
1	1½-in.	Bolt and pipe cutter	Landis Machine Co.
1	2-in.	Bolt and pipe cutter	Landis Machine Co.
1	2-in.	Single head bolt cutter	Landis Machine Co.
1	1½-in.	Triple head bolt cutter	Landis Machine Co.
1	1,500-lb.	Steam hammer	Massillon Foundry & Machine Co.
1	No. 2	Post borer	J. A. Fay & Egan Co.
1	4-in.	Hand planer and jointer	J. D. Wallace & Co.
2	6-in.	Hand planer and jointer	J. A. Fay & Egan Co.
1	8-in.	Hand planer and jointer	J. A. Fay & Egan Co.
1	15-in.	Disc sander and grinder	Porter-Cable Machine Co.
1	43-in. by 8-in.	Triple drum roll feed sander	P. B. Yates Machine Co.
1	30-in.	Band saw	J. A. Fay & Egan Co.
1	48-in.	Circular saw sharpener	Machinery Company of America
1	No. 2	Electric rivet heater	American Car & Foundry Co.
2	6,000-lb.	Pneumatic hoists	Independent Pneumatic Tool Co.
1	1,000-lb.	Electric hoist	Shepard Electric Crane & Hoist Co.
1	2,000-lb.	Electric hoist	Shepard Electric Crane & Hoist Co.
3	10,000-lb.	Electric hoists	Shepard Electric Crane & Hoist Co.
1	3,000-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.

St. Paul Bridge & Terminal Co.

1	1-hp.	Electric bench grinder	Cincinnati Electrical Tool Co.
1	2-in.	Flue cleaning machine	Lagonda Manufacturing Co.

Southern

2	26-in.	Upright drills	W. F. & J. Barnes Co.
1	48-in.	Drill press	Reed-Prentice Co.
1	18-in. by 8-ft.	Engine lathe	Cisco Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	36-in. by 36-in. by 10-ft.	Planer	Niles-Bement-Pond Co.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	53-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	No. 76	Floor grinder	Safety Emery Wheel Co.
1	18-in. by 18-in., 12-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	18-in. by 18-in., 14-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	18-in. by 18-in., 16-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	No. 14 K	Hacksaw machine	E. C. Atkins & Co.
1	4½-in. by 6-in.	Boring bar	H. B. Underwood Corp.
1	No. 102	Boring bar	H. B. Underwood Corp.
1	26-in.	Valve seat planer	H. B. Underwood Corp.
1	2-in.	Bolt cutter	Niles-Bement-Pond Co.
1	62-in.	Pressure blower	Buffalo Forge Co.
1	No. 536	Car tenoner and gainer	Greenlee Bros. & Co.
1	36-in.	Rip saw	Greenlee Bros. & Co.
1	No. 456	Cut-off saw	Greenlee Bros. & Co.
1	No. 325	Knife balancing machine	J. A. Fay & Egan Co.
1	No. 101	Knife grinder	J. A. Fay & Egan Co.
1	200-amp.	Electric welding outfit	Westinghouse Electric & Mfg. Co.

Southern Pacific

1	Type FFA	Cincinnati grinder	Waterhouse & Lester Co.
1	1½-in.	Landis bolt threading machine	Woodward, Wight & Co.
1	¾-in.	Upsetting and forging machine	Acme Machinery Co.
3		Wire nail making machines	National Machinery Co.

1	10-ft.	Locomotive crane truck	W. F. Hebard Co.
1	200-amp.	Arc welder	Westinghouse Electric & Mfg. Co.
1	35-ton	Hydraulic testing machine	Jos. T. Ryerson & Son.

Wabash

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Putnam journ. turn. and axle lathe	Manning, Maxwell & Moore
6	18-in.	Engine lathes	Lehmann Machine Co.
2	24-in.	Engine lathes	Lehmann Machine Co.
1	30-in.	Engine lathe	Boye & Emmes Machine Tool Co.
2		Hand lathes	U. S. Metallic Packing Co.
2	3-ft.	Radial drills	American Tool Works
1	26-in.	Upright drill press	Niles-Bement-Pond Co.
1	44-in.	Upright drill press	W. F. & J. Barnes Co.
1	No. 2	Drill press	Avery Drilling Machine Co.
1	32-in.	Crank shaper	Ohio Machine Tool Co.
1	32-in.	Crank shaper	J. J. O'Brien Machinery Co.
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
1	24-in. by 71-in.	Bar grinder	Diamond Machine Co.
1	No.66-A	Pattern maker's lathe	Oliver Machinery Co.
1	32-in.	Knife grinder	Hall & Brown Woodwk. Mach. Co.
1	52-in.	Saw blade sharpener	Jos. T. Ryerson & Son
2	20-in.	Emery wheel stands	Norton Co.
2	20-in. by 3-in.	Emery wheel stands	Elliot-Stephens Machine Co.
1	No. 5	Hack saw	Armstrong-Blum Mfg. Co.
1	No. 8	Metal cutting band saw	Armstrong-Blum Mfg. Co.
1	No. 109	Cylinder and dome facing machine	H. B. Underwood Corp.
1	No. 121	Valve chamber boring bar	H. B. Underwood Corp.
1	1½-in.	Double head bolt cutter	Landis Machine Co.
1	2-in.	Double bolt threader	National Machine Co.
1	No. 2B	Pneumatic hammer	Nagel Engineering & Machine Co.
1	3-in.	Alligator type shear	Canton Foundry & Machine Co.
1	Type C 3-LU	Punch and shear	Henry Pels & Co.
1	No. 12763	Stewart oil-burning hammer forge	Chicago Flexible Shaft Co.
1	No. 4	Oil-burning forging furnace	Ferguson Furnace Co.
1	No. 232	Hollow chisel mortiser	Greenlee Bros. & Co.
1	24-in.	Self-feed rip saw	Greenlee Bros. & Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.
1	No. 264	Self-feed rip saw	J. A. Fay & Egan Co.
1	No. 42770	Hand shaper and router	R. L. Carter Co.
1	5-ton	Pneumatic hoist	Detroit Hoist & Machine Co.
1	350-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.
1	500-cu. ft.	Steam-driven air compressor	Worthington Pump & Mchy. Co.
1	1,000-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.
1		Air brake hose stripping and mounting machine	Westinghouse Air Brake Co.
3	150-gal.	Paint mixers	J. H. Day & Co.
1	No. 1	Rubber testing machine	Tinius Olsen Testing Mach. Co.

Western Pacific

1	5-ft.	Radial drill	Ryerson Conradson Co.
1	7½-in. by 34-in.	Grinding machine	Gisholt Machine Co.
1	No. 2	Mortiser	New Britain Tool & Mfg. Co.
1	No. 5	Tenoner	L. Power Co.
1	30-in. by 6-in.	Smoothing planer	P. B. Yates Machine Co.
1	295-cu. ft.	Air compressor	Westinghouse Air Brake Co.
1	315-cu. ft.	Air compressor	Westinghouse Air Brake Co.
1	200-amp.	Electric welder	U. S. Light & Heat Corp.

Wheeling & Lake Erie

2	200-amp.	Arc welders	Westinghouse Electric & Mfg. Co.

Yazoo & Mississippi Valley

1	20-in. by 10-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	No. 263	Upright drill	W. F. & J. Barnes Co.
1	20-in.	Crank slotting machine	Wm. Sellers & Co., Inc.
1	No. 2	Radius link grinder	Rockford Milling Machine Co.
1	⅛-in. to 2¾-in.	Twist drill grinder	Oliver Instrument Co.
1	18-in. by 3-in. by 1½-in.	Double floor grinder	U. S. Electrical Tool Co.
1	No. 304-B	Pipe threading and cutting-off machine	Oster Manufacturing Co.

Manufacturing and stocking bolts in the shop

By Eugene Kennedy

THE idea of manufacturing bolts of various sizes on a Lassiter four-spindle bolt-turning machine, a turret lathe equipped with a taper attachment, or some similar machine, is an old one. But the establishing of a system for the manufacturing and stocking of finished bolts has not been done so extensively. Fig. 2 shows two sample pages taken from a reference book which contains in table form the dimensions of the various bolts that are manufactured in the shop. This book contains all the data necessary to make locomotive frame bolts, main rod strap bolts, crosshead guide bolts, eccentric strap bolts, crosshead bolts, miscellaneous studs that have been adopted as standard, crosshead studs, and boiler studs. The pages are in blue print form, making a book 9 in. by 2¾ in. wide, a size convenient to carry in one's pocket.

Orders for finished bolts to be placed in stock are issued by the stores department. The order blank shows the number of bolts desired and the section and line number for obtaining the correct data from the reference book. The blacksmith shop procures the round bar, cuts it to the proper lengths, forms the heads and delivers the bolts to the pointing machine after which they are turned on a bolt-turning machine and delivered to the storeroom. Copies of the reference book are furnished to the mechanics engaged in the various operations of manufacturing the bolts.

The operator of the bolt-turning machine is supplied with a complete set of gages with which to gage the bolts for diameter and taper. The mechanic in the erecting shop also has access to an identical set of gages so that when reaming a hole he can, upon completion, select a gage which will fit the finishing reamer the same as a bolt should fit the reamer hole. The diameter stenciled on the gage shows the size required and the length is readily ascertained with a rule. This information makes the interpretation of the data given in the reference book comparatively simple.

This system, as outlined, has been used to good advantage in the locomotive shops of the Delaware & Hudson at Colonie, N. Y. It has been found to be much better than the usual practice of fitting bolts by turning on portable engine lathes, which is obviously a slow and costly method. Referring to the sample pages of the reference book shown in Fig. 2, it will be noted that a prime diameter, such as ⅞ in., is shown on the first line under the capition "Size." This is followed by the various

SIZE, WEIGHT, MATERIAL AND MANUFACTURING COSTS OF FINISHED FRAME BOLTS

Diameter of Rough Bar Iron Used	1"				1 1/8"				1 1/4"			
Diameter of Finished Bolts	7/8", 29/32", 15/16"				31/32", 1", 1 1/32", 1 1/16"				1 3/32", 1 1/8", 1 5/32", 1 3/16"			
Length of Bolt - in.	Weight per 100	Cost per 100			Weight per 100	Cost per 100			Weight per 100	Cost per 100		
		Labor	Material	Total		Labor	Material	Total		Labor	Material	Total
3	117	2.45	7.66	10.11	154	2.45	10.09	12.54	199	2.55	13.03	15.58
3½	128	2.50	8.38	10.88	168	2.50	11.00	13.50	216	2.60	14.15	16.75
4	139	2.50	9.10	11.60	182	2.50	11.92	14.42	233	2.60	15.26	17.86
4½	150	2.60	9.83	12.43	196	2.60	12.84	15.44	250	2.70	16.38	19.08
5	161	2.60	10.55	13.15	210	2.60	13.76	16.36	268	2.70	17.55	20.25
5½	172	2.70	11.27	13.97	223	2.70	14.61	17.31	285	2.80	18.67	21.47
6	183	2.70	11.99	14.69	237	2.70	15.52	18.22	302	2.80	19.78	22.58
6½	194	2.80	12.71	15.51	251	2.80	16.44	19.24	319	2.90	20.89	23.79
7	204	2.80	13.36	16.16	265	2.80	17.36	20.16	336	2.90	22.01	24.91
7½	215	2.90	14.08	16.98	279	2.90	18.27	21.17	353	3.00	23.12	26.12
8	226	2.90	14.80	17.70	292	2.90	19.13	22.03	370	3.00	24.24	27.24
8½	237	3.00	15.52	18.52	306	3.00	20.04	23.04	387	3.10	25.35	28.45
9	248	3.00	16.24	19.24	320	3.00	20.96	23.96	404	3.10	26.46	29.56
9½	259	3.10	16.96	20.06	334	3.10	21.88	24.98	421	3.20	27.58	30.78
10	270	3.10	17.69	20.79	348	3.10	22.79	25.89	438	3.20	28.69	31.89
11	292	3.20	19.13	22.33	375	3.20	24.56	27.76	472	3.30	30.92	34.22
12	313	3.30	20.50	23.80	403	3.30	26.40	29.70	506	3.40	33.14	36.54
13	335	3.40	21.94	25.34	430	3.40	28.17	31.57	540	3.50	35.37	38.87
14	357	3.50	23.37	26.87	458	3.50	30.00	33.50	574	3.60	37.60	41.20
15	379	3.60	24.82	28.42	486	3.60	31.83	35.43	609	3.70	39.89	43.59
16	401	3.70	26.27	29.97	513	3.70	33.60	37.30	643	3.80	42.12	45.92
17	422	3.80	27.64	31.44	541	3.80	35.44	39.24	677	3.90	44.34	48.24
18	444	3.90	29.08	32.98	568	3.90	37.20	41.10	711	4.00	46.57	50.57

NOTES: Material cost based on iron, up to 2" @ $.0655 and 2" iron @ $.067.
Labor cost includes shearing, forging, centering, machining and handling, but does not include overhead.

Fig. 1—Chart by which the accounting department can determine the cost of manufacturing bolts of various sizes

lengths of bolts which advance in ½-in. sizes from 2½ in. up to 9½ in. Each size is assigned to a separate line and all of the sizes of bolts in use having this particular diameter range from the minimum to the maximum sizes as shown. It will also be noted that the diameter increases by 1/32 in. in order to provide for repeated reaming. At the top of the page there is an explanation of the procedure to be used in ordering bolts from stock to fit the reamed hole.

A number of charts, one of which is shown in Fig. 1, have been compiled for the convenience of the accountant in distributing charges accruing on shop orders for bolts. It had been the customary practice to use figures from hand books, catalogues, or manufacturers' price lists for such information as contained on this chart. Information obtained from such sources was not always suitable.

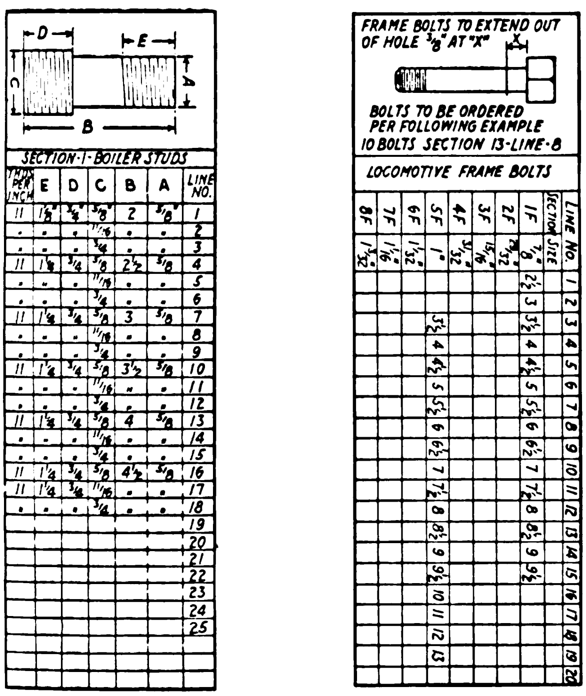


Fig. 2—Sample pages taken from the reference book showing the dimensions of standard bolts

Manufacturing costs vary considerably according to the production methods in use, type of equipment, etc. There is often a wide discrepancy between the actual amount of labor and material expended and the amount which eventually is reported to the accounting department if the charges are determined from time cards. For example, a shop order for 100 finished bolts should accumulate a certain material and labor charge, depending, of course, upon the dimensions. The labor item in all probability is likely to receive a considerable overcharge or vice versa due to an incorrect distribution of charges made by the workmen. This chart was compiled on a decimal basis in order to correct such errors and provide a fixed charge for bolts of all sizes.

Referring again to Fig. 1, it will be noted that the diameter of the rough stock is given. This is subdivided into the finished sizes which, on account of machining, are obviously of smaller diameter. The weights given are for the rough bar after it has been cut to length and previous to forming the head. As the bar from which the bolts are cut is the item which has been bought and paid for, it is obvious that the accounting department is not interested in the weight of the finished bolt. The footnote on the chart explains the basis upon which the material and labor costs have been ascertained.

Complete set of bushings renewed in 1 hr. 9 min.

By J. M. Ganley

Secretary to superintendent of motive power, Wabash, Decatur, Ill.

On August 10, the Wabash enginehouse forces at Decatur, Ill., renewed a full set of driving rod bushings and knuckle joint bushings in 1 hr. 28 min., but not being satisfied with that, they bettered the time by 19 min. on September 12.

The Wabash Pacific type passenger locomotive No. 664, assigned to fast passenger service between St. Louis, Mo., and Chicago, arrived at Decatur on train No. 13 at 2.45 on the morning of August 10, 1925. It was placed in the enginehouse by the night force and spotted on the left bottom quarter so as to be in position for the renewal of the rods on the left side by the day shift which started work at 7.00 a. m.

At 7.00 a. m. the work of removing the rods was started by the day forces. The left rods, including all side rods, main rod, motion work and eccentric crank were removed and on the floor at 7.08 a. m. The rods were then removed to the enginehouse machine shop where new bushings, including knuckle pin bushings, were applied. They were then returned to the enginehouse and reapplied to the left side of the engine. The main rod motion work, side rods, collar pins, knuckle joint pins and cotter pins, were all in place and the left side of the locomotive was completed at 8.05 a. m.

The right rods were removed and on the floor at 7.19 a. m. The work of removing the rods on the right side was slightly delayed due to the right front collar bolt being galded in the crank pin and it was necessary to use an acetylene torch to burn the bolt out. It was also necessary to use an acetylene torch to burn the nut off of the right knuckle joint pin on account of the cotter pin breaking off in removal and not being able to back it out. The right rods were moved to the machine shop at 7.21 a. m. All new bushings were applied and the rods returned to the enginehouse and reapplied to the locomotive. The right side of the locomotive was completed at 8.28 a. m. and the locomotive was moved out on the turntable at 8.29 a. m. It was dispatched on train No. 9 the same day, at 9.50 a. m.

The total time consumed in performing the work of renewing the entire set of side rod and knuckle joint bushings was as follows:

Time	1 hr. 28 min.
Total man hours	11 hr. 15 min.
Total labor cost	$8.25

In the man-hours is included the time of the gang foreman and the machine foreman.

Not satisfied with this performance, the enginehouse forces at Decatur decided that they could better this and on September 12, 1925, they undertook a similar job on locomotive No. 665, a Pacific type passenger locomotive of the same class as No. 664.

The 665 was spotted in the enginehouse by the night force, as in the case of the 664, but nothing further was done by the night force. At 7.00 a. m. the day shift came on and immediately started the renewing of the bushings on the 665. The eccentric crank, eccentric rod, main rod and all side rods on the left side were on the floor at 7.02 a. m. All rods, eccentric crank, and eccentric rod on the right side were on the floor at 7.04 a. m.

All old bushings were removed from the left rods, new bushings were applied and the rods, eccentric crank and

eccentric rod were in place on the left side of the locomotive at 7.40 a. m.

All the old bushings were removed and new bushings applied to the right side rods and the rods were ready to go up at 7.50 a. m. Difficulty was experienced in getting the right back rod on the pin, having to slip the back drivers on account of the locomotive standing on the right back center. It was necessary to get a switch engine and move the 665 on to the bottom quarter. The right rods were up and everything completed at 8.09 a. m. and the locomotive was moved to the turntable at 8.09 a. m. It left Decatur with train No. 9 at 9.50 a. m.

The total time consumed in renewing the complete set of side rod and knuckle joint bushings on this locomotive was as follows:

Time	1 hr. 9 min.
Man hours	17 hr. 10 min.
Total labor cost	$10.33

The machinery used in both cases was the same. Following is a list of the machine tools that were used for this job:

12-in. lathe	Niles boring machine
30-in. American lathe	Columbia shaper
Bement drill press	Chambersburg rod press
18-in. Prentice lathe	

Absolutely no work of any kind was started on these locomotives prior to 7.00 a. m. except, as has been mentioned, the spotting of the locomotives on arrival in the enginehouse and placing the bushings, in the rough, at the various machines in the machine shop.

The work on locomotive No. 664 was timed by the general road foreman of engines, who was at the enginehouse prior to the time the work commenced to see that no work was done. In the case of the 665, the shop superintendent, the chief draftsman, the traveling boiler foreman, and the road foreman of engines examined the locomotive and bushings before the work actually started to see that nothing had been done and then timed the work from the start until the locomotive was out on the turntable.

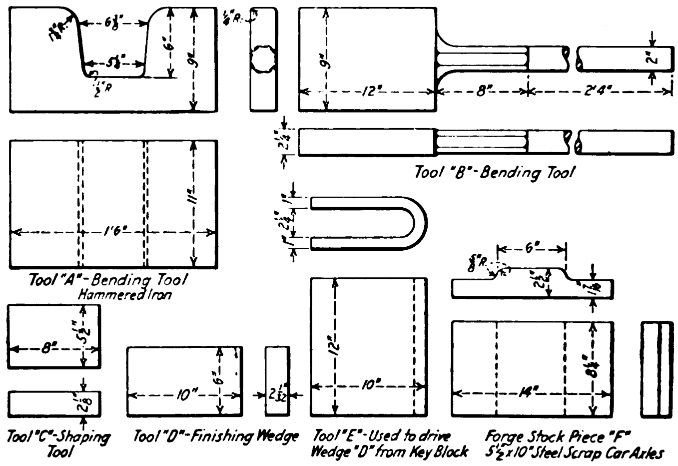
During the renewal of the bushings on the 665, delays were experienced which amounted to 10 min. The first delay occurred in the machine shop, where all of the machines are operated by a lineshaft, which is run by one motor. The belt slipped off the motor pulley causing all the machines to be idle three minutes, while the belt was being replaced. The next delay occurred when applying the rods to the right side, as it was necessary to send for a switch engine, which had to come across the turntable and into the house in order to move the 665 and spot it on the lower quarter. This caused a delay of seven minutes.

Forging back end main rod key blocks

By E. A. Miller

CONSIDERABLE time and expense can be saved in the manufacture of back end main rod key blocks by the use of the forging tools shown in the drawing. The old method of doing this work was to machine each piece from a solid forging after it had been planed up and cut to length. This method eliminates the tedious job of drilling and slotting the block and also saves considerable time.

Referring to the drawing, the piece *F* which is forged from a 5½-in. by 10-in. scrap car axle to the shape shown, is heated and laid with the hump side down on the forming tool *A*. Tool *B* is then placed on the hot forging directly above the groove in tool *A* and the forging is bent to shape by forcing tool *B* down on either a press or a steam hammer until the forging touches the bottom of the groove. The tool *B* and forging is then taken out of the forming tool *A* and is shaped up under the hammer,

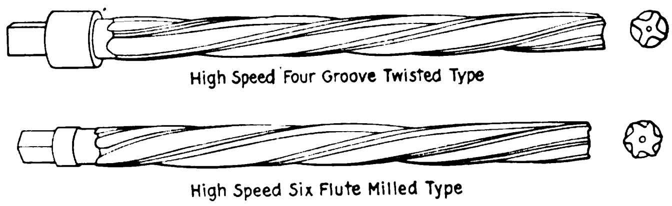


Drawing showing a set of tools used in forging back end main rod key blocks

using the shaping tool *C* first, and then finishing with tool *D*. The tool *E* is used to drive the wedge, tool *D*, from the key block. After a minimum amount of machining the key block is ready for application.

Standard reamer proposed by Tool Foremen

ON September 3, 1925, the American Railway Tool Foremen's Association in convention at Chicago, voted to recommend the adoption of standard locomotive frame and rod reamers, drawings of which are reproduced with this article. These reamers will range in size from 1 in. to 2 in. by 1/32-in. steps. The standard flute lengths are 8-, 12-, 16-, 18-, 22- and 26-in., the taper being 1/16



Standard four- and six-flute reamers proposed by the Tool Foremen's Association

in. in 12 in. The spiral is left hand and the spiral angle, 12 to 20 deg. Square shanks are recommended in the 1-in., 1⅛-in., and 1¼-in. sizes, the length of the square being 25 per cent greater than the distance across the flats. The flutes are machine ground to obtain an accurate spiral, the cutting edge being ground with double relief and recessed under the heads to provide run-out for the grinding wheel.

Two types of reamers are approved, namely the high-speed, four-groove twisted type and the high-speed, six-flute milled type.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

"The proof of the pudding"

New York

To the editor:

The "Bill Brown—Top Sergeant" controversy is quite interesting. However, it seems that the real basis of comparison has been overlooked—COSTS. It is a case of the final decision resting with the banker. The last group of complete mileage costs shows that "Bill Brown's" road maintained its power for a little more than 19 cents per locomotive mile. The writer does not know who "Top Sergeant" is so he has taken the costs of the twelve "hardest-boiled" railroads in the United States and finds their costs average 37.6 cents per mile. Military methods are all right in emergencies when costs don't count. But in peace times—muster the firing squad and page the undertaker!

Dollars and Sense

Savings on repair costs

Newark, N. J.

To the editor:

It is an established fact that the longer a locomotive remains in the shop, the more it costs to repair. This is due to several existing practices, which if changed, would not only reduce the costs of repairs, but also give an added output from the shops.

Locomotives are carded in the shop, needing, let us say, a new cylinder, when the parts needed are not on hand. This locomotive cannot be built in the proper time on account of the missing material. It stands on a pit taking up room that should be occupied by an engine which could be repaired. Also, it is eating up a shop expense of $39.00 a day.

The essential contributing factor to such a situation is that the locomotives do not receive the proper inspection before coming to the shop with the result that defective parts are not located until the engine is in the shop and stripped.

Again, under the present methods of accounting, men must charge out their time against some locomotive. As a result of this practice, a locomotive that is in the shop a long time receives an incorrect labor charge, due to the men bceoming too familiar with the engine number. To remedy these conditions, I would suggest that a thorough inspection be made of a locomotive about due for the shop and the standard defective parts noted. The report should be forwarded to the shop scheduled to make the repairs; the parts obtained and machined as far as possible ready to apply, before the locomotive is ordered in. The locomotive could then be rebuilt rapidly and the time out of service greatly reduced.

An engine comes into the shop for a class five repair and should be out again in nine working days. The report shows a new cylinder and new tires needed. When stripping the locomotive, it is found that both cylinders need renewing. There is only one cylinder on hand and three weeks is lost before the cylinders are ready to apply with the result that the engine is in the shop a month. If the shop were notified that two new cylinders and new tires were needed for a locomotive, it could secure the parts, lay out, drill, bolt and chip the cylinders and bore the tires. It would then notify the enginehouse that it was ready for the locomotive which could be repaired in less than the allotted time. This would mean that standards would have to be maintained and that any variations from them be kept on record. The method of accounting would have to be changed to take in the advanced machine cost so as to cover classified repairs.

I believe that this would lead to a saving in that it would cost nothing in the way of new equipment, men, etc., but would utilize present facilities to better advantage. Less time in shops means more locomotives in service and reduced cost of repairs.

Schedule Supervisor

Sympathizes with "Top Sergeant"

Michigan

To the editor:

"Top Sergeant" submitted an article in your August number that has brought down upon his head the wrath of a majority of the contributors to the "Bill Brown-Top Sergeant" controversy. Sober analysis should mellow the harsh words levelled at him by those who appear to be "sitting pretty." We might be dealing with the finest type of man; competent as a workman, keen, efficient as a supervisor, and a good organizer. With all these able qualities, what would they profit him if his superior, the superintendent of motive power, was of the old school, who had no regard for the men's point of view and who still lived in the glories of his success of yesterday and insisted that his supervisors follow in his wake? This is not far removed from the actual. I have been up against its parallel and sacrificed my position rather than be coerced into doing something my convictions would not permit

The general manager of a plant supervised by the writer was of a type that instead of "Will you do it?" said "You will do it." Each day he would walk through the various departments of the plant taking notes. On Wednesday morning the entire supervisory force was called in for what was termed a conference. The general manager assumed the role of a dictator and no one dared speak his thoughts nor offer any defense of the charges made against him. The individuals were each sought out; the "Big Boss" would walk from behind his desk with fist closed and deliberately shake it while admonishing, abusing and swearing at the one under indictment. I was called in just once and when my turn came the practice was tried on me and the battle was on. I broke up his party and was never again invited to attend. The men, after taking the abuse, would file out, dejected, hateful, resentful and vindictive; for the preservation of their jobs throughout the week they could do but one thing, and they did it. The

plant about which I have just written is industrial and employs some three hundred men.

A superintendent of motive power, passing through a shop, came suddenly upon a foreman reading and at the same time studying an article in a mechanical paper. The article in question contained some valuable information upon a problem the foreman was about to deal with. Explanation of this did not soften the abuse meted out. To his everlasting shame the autocrat, in the course of his discourse, told the foreman in the presence of many of his men that when there was any reading of magazines to be done, he, the superintendent of motive power, would do it, and that the foreman was paid to supervise and do his studying and reading at home. The particular foreman in question was always late leaving the job and was first back to it, so that his home time was spent trying to gather some six or seven hours much needed sleep.

A flash of what I am trying to convey was given you by the "Top Sergeant" when he said: "He would very probably and in my opinion quite justly be canned by our superintendent of motive power as being unfit supervisory material." The superintendent of motive power is as much at fault that men are hard-boiled as any other factor. A man in constant fear of abuse for things he does and does not do cannot meet his problems with a smile. It is too much to expect of any human. Though he may have the ability, the other factors will be concealed in a cloak of indifference and for his self-preservation, the supervisor will proceed to take it out on the other fellow.

I can recall instances, and they are comparatively recent, when any measure short of personal injury would not have been too severe to administer to subdue certain disturbing elements. Labor, the commodity, is human as well as mechanical and is a variable and versatile quantity and as such must be dealt with. One time it is the individual and another it is the whole body. Many conditions must be examined and dealt with. Shop conditions, location, relative availability of work, are factors, and determining ones, on the relation of the men toward their supervisors. If you have a body of intelligent and fair workmen, where little disturbance from within or without is ever encountered, you are fortunate. The "Top Sergeant" may have inherited a body of I. W. Ws, or communists; the "riff-raff of industry, whose sole aim is its domination. This would tax the capacity, tact and ability of a superman and only a hard-boiled supervisor could handle the situation. This condition actually exists on railroads and it takes the iron hand of a disciplinarian to cope with it.

The questions involved in this issue are co-ordinated with the "bread-and-butter" problem, which is the biggest question any government or people are called upon to deal with. The man on the job knows best what measures to apply. When things go along it is dandy to talk and write a story of how easy matters can be handled and adjusted, but bump into the reverse and this same supervisor will change his song story to one of hate. The supervisor is only human. A million petty things, personal and otherwise, inspire men to do some seemingly very unjust things.

A liberal interpretation of the article written by the "Top Sergeant" might give us room to criticize him. He is not a bad man, but human, rather frank, and you must admit he has the courage of his convictions whether you agree with him or not. That he is a reader of technical and mechanical journals is evidenced by the fact he saw the article of "Bill Brown."

The success of dealing with men in any supervisory capacity is the ability of the supervisor to measure up to conditions and situations as they demand. You cannot handle these situations from a book written by someone, somewhere, who has never passed through the fire.

The Chaplain

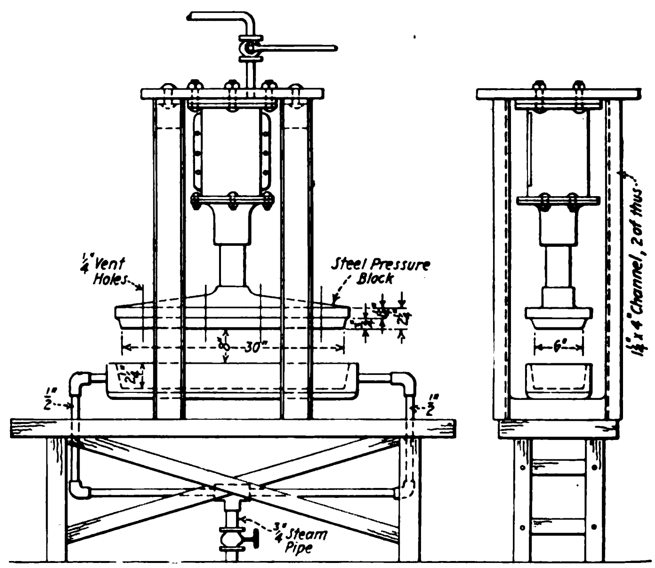
Reclaiming asbestos lagging

BROWNWOOD, TEX.

TO THE EDITOR:

Practically every railroad shop in the country attempts to reclaim a part of or all of its asbestos locomotive lagging. Mr. Nygren's question, which was published in the September *Railway Mechanical Engineer,* especially as to the pressure required, should be of interest to many shop foremen. I have had some experience along this line and have had some of the difficulties usually met with in molding.

A device for molding reclaimed asbestos locomotive lagging is shown in the sketch. This sketch is not detailed and is only shown to give the reader an idea to work on and help solve the problem. The device consists



Sketch showing device for molding reclaimed asbestos blocks

essentially of a steam jacketed box for molding and an 8-in. air brake cylinder with a steel pressure block in which is drilled a number of 1/4-in. vent holes, attached to the piston. Steam for drying the asbestos block, is piped to the molding box, which is lined with 1/4-in. sheet metal. The inside of the box is tapered so as to facilitate the removal of the asbestos block.

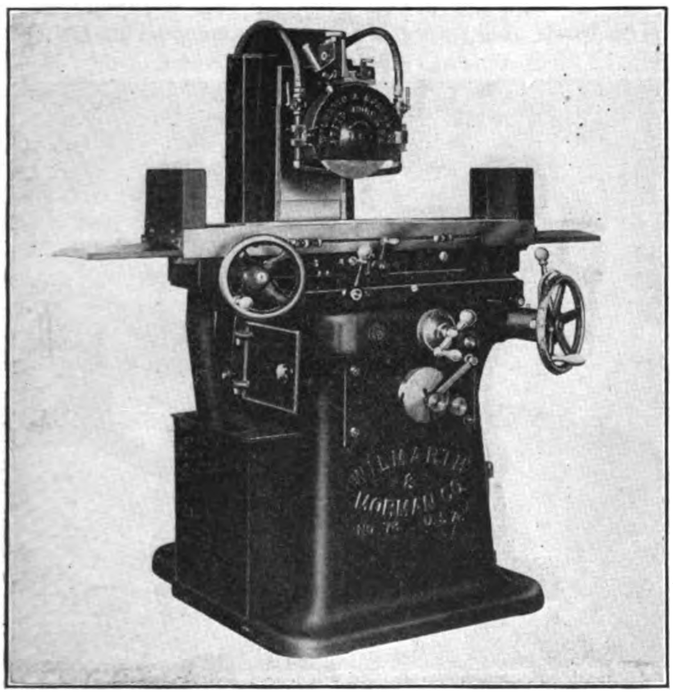
In mixing the mud do not let hard bits enter the mold and do not use too much water. Fill the box full of the asbestos mud and then press to form the block. By having two or three different thicknesses of pressure plates, say one each of 3/4 in., 1 in. and 1 1/4 in., you can obtain as many block sizes. This device can also be built to make more than one block at a time.

A READER.

THE CHICAGO & NORTH WESTERN is making a series of tests of oil-electric locomotives in switching service in its freight yards in Chicago. Both the locomotives built jointly by the Ingersoll-Rand Company, the American Locomotive Company, and the General Electric Company and the Diesel type, developed by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company, are being tested. The North Western also has purchased two rail motor coaches for use in branch line passenger service.

Surface grinder with motor mounted in the base

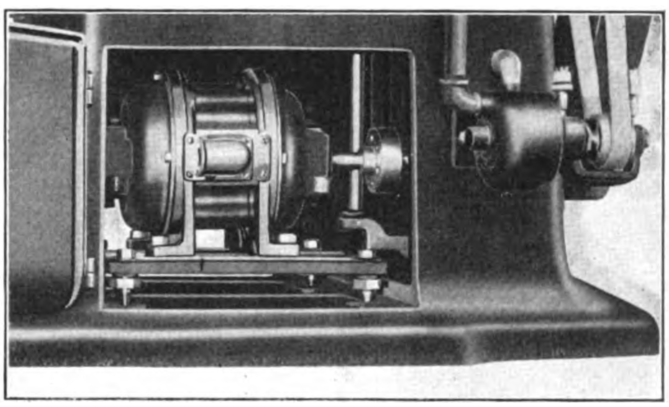
SEVERAL improvements have recently been incorporated in the construction of the No. 78 super-surface grinder built by the Wilmarth & Morman Company, Grand Rapids, Mich. Ready access to the various mechanisms, a drive that is mounted on ball bearings, a flexible coupling from the motor, a ball bearing clutch, ball and roller bearings in place of bronze, a patented spindle with positive take-up and direct flow of coolant from the saddle to the coolant tank are features of the machine illustrated.



All operating control levers on the Wilmarth & Morman No. 78 surface grinder are easily accessible to the operator

As in the original machine, the controls have been located for the convenience of the operator. The elevating hand wheel is geared so the divisions on its dial are 5/32 in. apart, but register 0.0005 in. between divisions. This wheel is located at the right while the longitudinal table-feed handwheel is at the left side. There is a graduated cross-feed ball-crank handle, an automatic cross-feed throwout lever, with adjustable dogs to set for a desired width of grinding, and a longitudinal table starting and stopping lever for use in automatically transferring the table feed from power to hand operation. Clutches are used in this last named control so that the change is positive from one feed drive to the other. Feed at one or both ends of the stroke can be selected by turning a knurled knob near the center of the machine.

The spindle rides in deep-groove type ball bearings and is arranged to take up lost motion automatically. A hand-adjustable take-up is also included. All of the bearings are protected against the entrance of dust and grit.



The motor, mounted in the base compartment

The hardened steel clutch for use in reversing the table travel, is mounted on ball bearings on a hardened shaft, the balls acting as a driving key between shaft and clutch. This arrangement has been made to result in free action of the clutch and to eliminate jar at the point of table-travel reverse. The clutch is said not to slip prematurely or to stop on center.

The grinding wheel head travels vertically on flat ways located on the front and rear of the upright housing and between tapered ways within the housing. A take-up is provided at the rear of the wheel head and is designed for sensitive manipulation. There are two head-elevating screws with right and left-hand Acme threads arranged to work in unison. They are mounted in adjustable

bronze nuts which serve to compensate for lost motion in the elevating mechanism.

The table is mounted on two ways, one flat and one tapered, and is driven by means of a spiral rack and pinion. There is ample spread between the ways to insure steadiness in the arrangement.

In the saddle mechanisms and controls, simplicity has been featured. Large openings have been provided in this part of the machine to allow for free flow of the coolant from the saddle to the coolant tank. Sliding, telescoping dust guards protect the parts.

The main frame is a one-piece casting. This frame is provided with openings, to permit of access to all of the mechanisms within, including the gear box, the worm-feed gear and the automatic mechanism. This arrangement makes it unnecessary to lift the saddle or the table to get at these parts. The gear box contains the reversing gears that are driven by the ball-bearing clutch described.

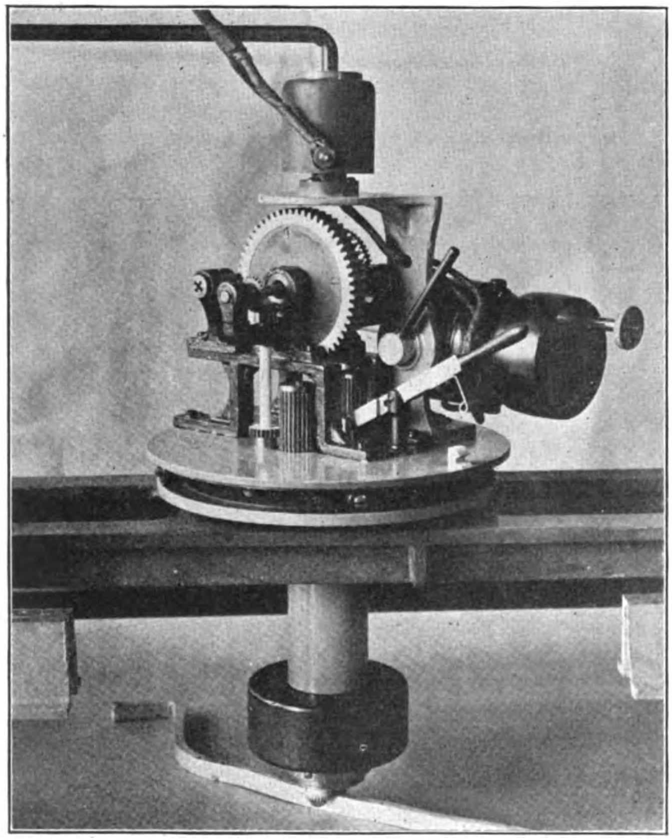
The machine can be arranged to be driven by a motor located inside the base. A 1½-hp., 1,200-r.p.m. motor is recommended for this service. A door, on each side of the base, makes the motor fully accessible and simplifies the problem of caring for it properly. The motor compartment is separated from the upper chamber containing the driving mechanism, connection from motor to drive being supplied through a ball-bearing drive shaft and a flexible coupling.

The machine is regularly furnished for wet grinding, the coolant being piped to both sides of the wheel to insure complete flooding of the work as it enters and leaves the wheel. The pump and piping are built into the machine.

The machine occupies a floor space of 44 in. by 86 in. and weighs 2,300 lb. net.

Gas automatic shape cutting machines

An automatic gas cutting machine designed to cut out of the solid such locomotive part as frames, side and main rods, links etc., has been placed on the market by the Automatic Cutting Machine Company, 66 Brookline avenue, Boston, Mass. The machine is completely automatic in its operation, as it runs on



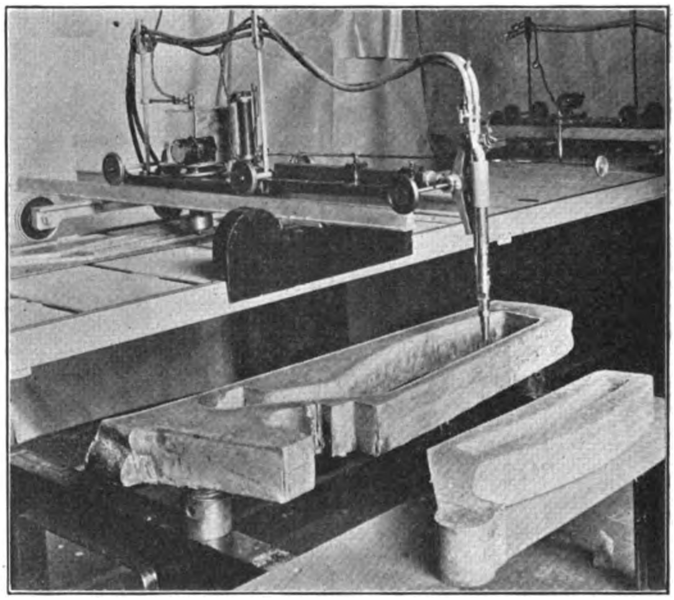
The driving mechanism, mounted on a turntable, easily follows any change of direction

two rails and the torch is guided by an aluminum template.

A table for the template is located on one side of the machine, while on the front side is the bed for holding the work. The piece to be cut is placed on the bed inside of the cutting range. The template is shifted to suit the path of the intended cut. The operator stands in front of the torch, manipulates the torch valves and adjusts the speed with a hand wheel. A rheostat allows the finest speed variations. With another hand wheel, the operator can raise or lower the torch to follow any surface irregularities of the work. Every adjustment is within his reach.

The machine proper has two perpendicular movements, both mounted on ball bearings and wheels instead of on slides. Thus, a few ounces of pull moves it anywhere.

The torch and tracer are rigidly connected and there



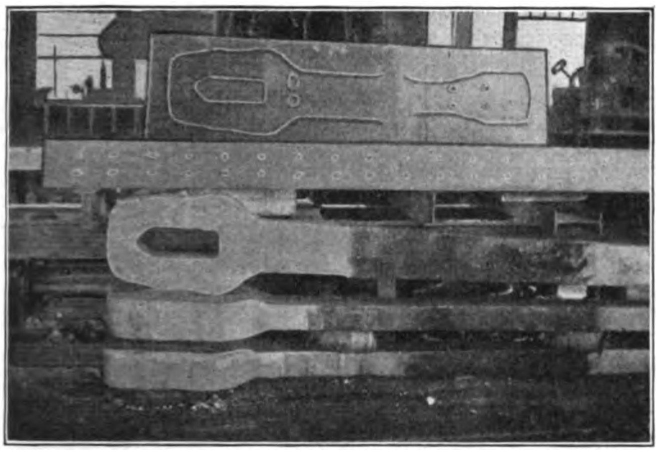
Automatic shape cutting machine cutting out Walschaert links

are no linkages in any part of the machine. Thus the reproduction does not suffer from loose joints or play in the bearings, which mar the exactness of the cut in proportion to the play in the joints.

The driving mechanism is mounted on a turntable which easily follows any change of direction without any side thrust. It imparts its movements to two sharp toothed cones located at the lower end of a well-centered floating tube. The two cones straddle an inexpensive aluminum strip, 7/16 in. high and ¼ in. wide, which is easily bent and rebent by hand into any desired shape. A weight presses the floating tube with the two straddling

cones tightly against the aluminum strip. When rotating, the two cones move the machine exactly over the course of the shape of the aluminum strip, and the torch moves in an exactly parallel course.

The relative rotating speed of the two cones, driven by a well-centered and balanced differential which eliminates any set thrusts, varies automatically. One cone can stop, as for instance in sharp corners, while the other cone swings around at full speed.



Locomotive main rods and template

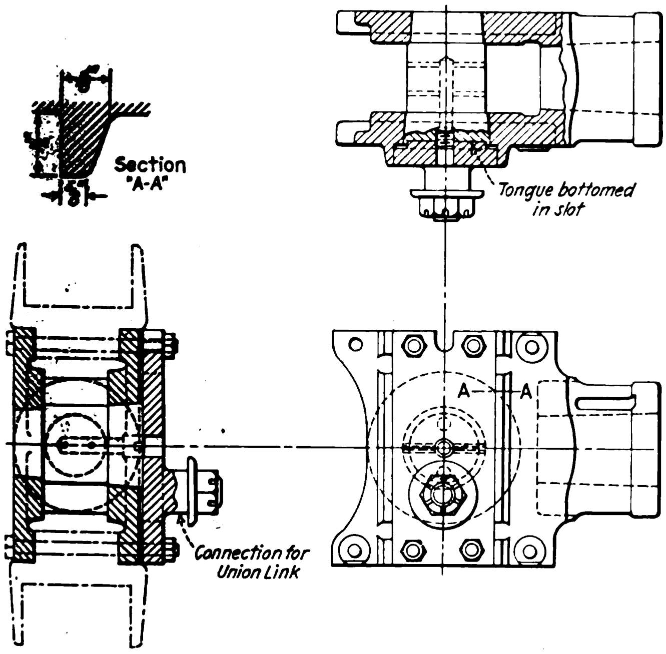
The torch traveling mechanism is driven by a small universal electric motor of about 1/75 hp., which drives a worm wheel on a pinion shaft. This, in turn, drives a gear wheel which is fitted with a differential system. Through this differential ends of the two vertical shafts are driven by bevel gears and these shafts drive the cone shafts through a pair of long idlers, which permit the floating tube containing the cone shafts to be lifted from the template without disengaging the gears. For the speed variations a rheostat is used with a long rod and handle reaching to a place near the torch. Furthermore, the driving motor is swivelled so as to allow the insertion of small or larger worm gears. In this way major speed variations can be obtained, which is an important feature in obtaining maximum production.

A template once made will always reproduce the same shape for worn bearings. The aluminum strips can be bent by hand and then spiked on a wooden board for one-time cuts, or riveted on a ⅛ in. steel plate for repetition work.

The floating drive is not a support, and no nearby forge hammers or other vibrations affect the machine. The floating drive will set in place to the template and not jump off the template.

Hubbard crosshead developed on Rock Island

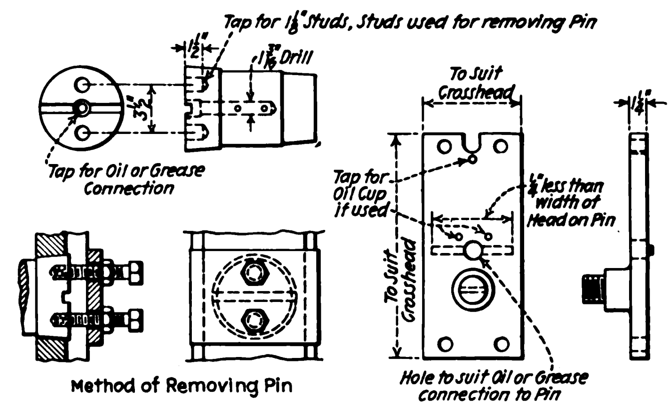
The Hubbard crosshead illustrated and described in this article originated on the Chicago, Rock Island & Pacific and has been used successfully for about two years on that road, being specified on the last few lots of new locomotives and applied in case of renewals. Perhaps the two most prominent features of the new crosshead are first, the arrangement for applying and removing the wrist pin from the outside, and second, the provision of lugs cast on the face of the crosshead to relieve the crosshead bolts of practically all shear.



General arrangement of the Hubbard crosshead used on the Chicago, Rock Island & Pacific

The wrist pin of the crosshead is applied or removed from the outside and cannot turn in the crosshead fit as a slot across the outside end is engaged by a tongue on the keeper plate. The keeper plate cannot turn as it is secured by two top and two bottom gib bolts, and the shear is taken off these bolts by lugs cast on the outside wing or cheek of the crosshead. Washers between the keeper and plate of the crosshead body give a metal to metal bearing throughout the entire length of the gib bolts.

This design saves time in enginehouses as it is not necessary to spot the engine to remove the wrist pin. Heavy modern locomotives are difficult to spot by pinching and in some cases it is impossible to get enough bars to the wheels to move them. To wait for the hostler to bring around a hot engine means many valuable minutes lost to the mechanic, and adds to the time required to turn the engine. Not only is this crosshead designed to reduce enginehouse turning time and facilitate making



Details of Hubbard crosshead arrangement—Method of removing the pin

running repairs, but in case of a breakdown on the road where it is necessary to take down the main rods, this can be done at once by the engine crew, again without waiting for help to spot the engine.

The design of the Hubbard crosshead is such that the wrist pin cannot work in as is often the case where nuts have worked off the ordinary style of wrist pin or when the end of the pin breaks with the nut and cotter key intact. The wrist pins for the new crosshead are fitted with draw, and have the tongue on the keeper plate bottom in the slot in the end of the wrist pin. The washers at the gib bolts in the end of the keeper plate are then made the necessary thickness to give a slight spring to the plate, thus keeping a substantial pressure on the wrist pin.

The union link trunnion is shown slightly below the wrist pin center, this arrangement permitting center lubrication of the wrist pin. The trunnion may be central over the pin, or the keeper plate may be of cast steel and extended down and out to meet any present location of the union link.

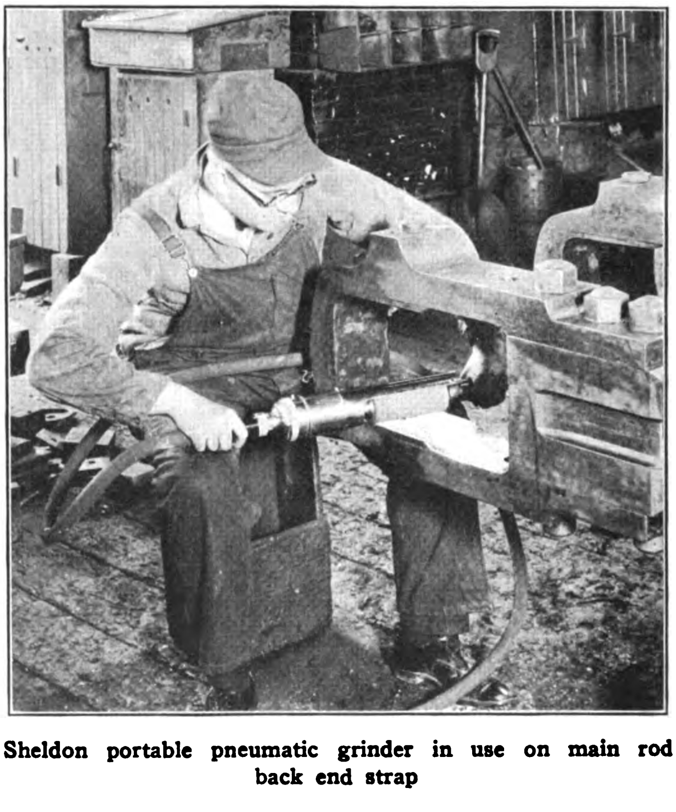
This crosshead, which is made by the Hubbard Steel Foundry Company, Chicago, can be altered in design to take care of any design of crosshead including the Laird type. Ordinarily the alligator type crosshead can be changed by simply adding the lugs which hold the keeper plate to the present pattern. Both right and left crossheads can then be machined on the same pattern. It is customary for the railroad to make the wrist pin and keeper plate but the manufacturer furnishes them to the railroad's blue prints if required. The crosshead fits are maintained practically standard for the life of the crosshead, it not being necessary to build up these fits and rebore them. This eliminates the necessity of welding which may set up stresses, sufficient to develop checks and cause subsequent crosshead failures.

Locomotive frame jaw grinder

A DEVICE known as the Sheldon locomotive frame jaw grinder has been developed and placed on the market recently by Manning, Maxwell & Moore, Inc., New York. As shown in the illustrations, this device is a portable tool, adapted to various re-surfacing operations in railroad shop work. The grinding wheel is driven by a direct-connected pneumatic turbine-type motor, mounted on standard radial ball bearings and lubricated by the Alemite system. The motor is designed with ample power to pull a six-inch face course grain grinding wheel when held firmly against a six-inch surface. The body of the tool, made from one piece of three-inch tubing about 15 in. long to assure accurate alinement of rotating parts, is so constructed that it covers one side of the grinding wheel affording ample protection.

The Sheldon grinder saves time in straightening worn frame jaws

The Sheldon grinder is simple in design, compact and accurately balanced. It is built for hard service, and maintenance costs should be negligible as there are no connecting rods or reciprocating parts to burn up or become loose. The tool is particularly designed to expedite re-surfacing jobs such as the squaring and straightening of locomotive frame jaws, preliminary to the application of new shoes and wedges. Under the action of wear, these jaws present a highly polished and almost case-hardened surface usually worn at least 1/32 in. out of true in locomotives which have made their mileage. Hand filing of these frame jaws is a slow and expensive operation and the Sheldon grinder with wide face wheels expedites this work. In addition, re-surfacing jobs on rod straps are said to be handled with this tool with a considerable saving over hand finishing methods. Most rod straps are an-

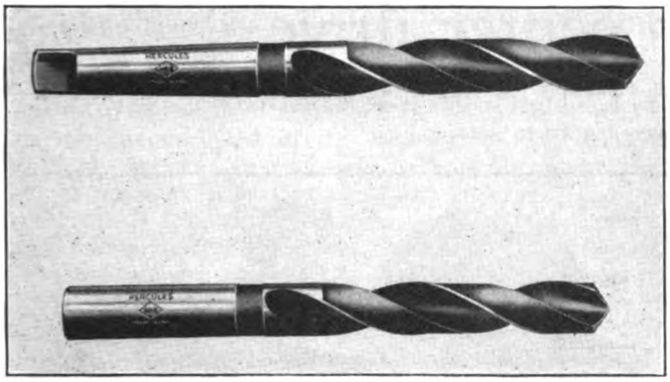


Sheldon portable pneumatic grinder in use on main rod back end strap

nealed at each shopping of the locomotive, and, in cooling, a surface scale forms which clogs the files and greatly retards hand finishing work. The Sheldon grinder is designed to save time, labor and file expense in grinding and polishing main and side rods and many other re-surfacing operations.

High speed tapered and straight shanked drill

THE original Hercules No. 550 high speed twist drill, was made with a hub at the large end of the shank. This was done to give additional strength to the already oversized shank to better permit driving a powerful tool. For certain jig work and in multiple spindle drill presses, this hub was, however, sometimes objectionable. The Whitman & Barnes Manufacturing Company, Akron, Ohio, has developed a new process of making shanks, doing away with the hub and permitting the new No. 555 drill to be used wherever a standard drill may be used. The drill is now made also in the straight shank which is designated by the manufacturer as the No. 444.



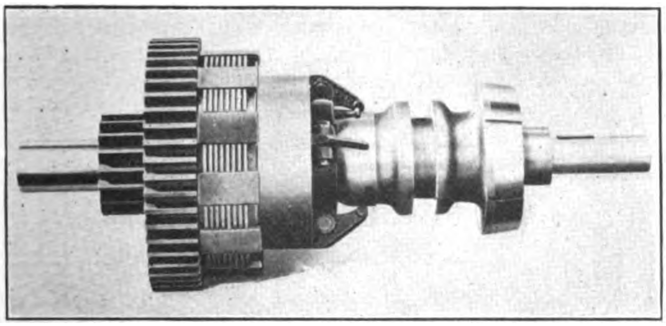
Hercules twist drills

This manufacturer has standardized and simplified its line of drills. Overall and flute dimensions correspond, size for size throughout the Hercules drills. In the carbon taper and straight shank tools the dimensions are made to correspond with the counterparts in the high speed drills. The new Hercules No. 555 and 440 have eliminated the old Hercules No. 550 and 500 as well as the Diamond drills No. 402 and 402-SP and No. 404. The purchaser may, therefore, select from a list of two drills, one taper and one straight shank, as against five drills heretofore.

Improvements made to milling machine

POWER rapid traverse to the table of all models of machines larger than the No. 1 and No. 2 S sizes, multiple disc friction clutch, an adjustable starting lever, centralized oiling for saddle and table, and independent table feed control are the new features added to the line of Milwaukee milling machines manufactured by the Kearney & Trecker Corporation, Milwaukee, Wis.

Power rapid traverse of the table is controlled by the long lever shown on the right-hand side of the knee.

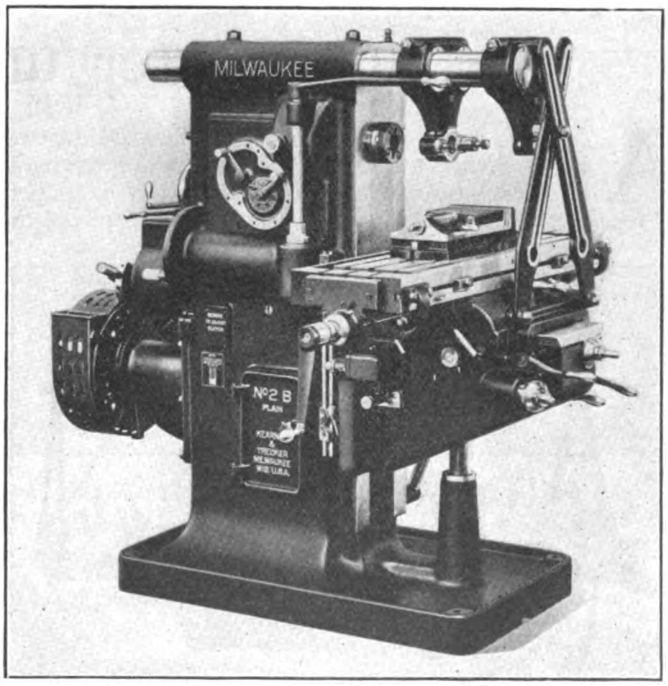


Multiple disc friction clutch which operates continuously under full load

Raising this lever causes the table to travel at the rate of 100 in. per min. in the same direction in which the table power feed is engaged. When the operator lets go of the lever, the normal table feed is again resumed.

The new multiple disc clutch, shown in one of the illustrations, is said to work continuously under full load and to be smooth and positive in operation. The discs are amply separated when disengaged, eliminating all tendencies to drift and a cone type brake is provided for quickly stopping the spindle. Tools are not required for adjusting and the pin adjustment provided is said to permit of quick adjustment that is uniform over the entire frictional area.

The new adjustable starting lever, which operates the



Redesigned Kearney & Trecker milling machine, showing the starting lever which operates the multiple disc friction clutch

friction clutch, extends to the front of the machine on the left side of the double overarms. This lever may

be adjusted to any angle to suit the convenience of the operator, or swung completely out of the way to accommodate large work.

Centralized table feed control is accomplished by a single lever directly at the front of the table, this lever engaging the automatic longitudinal feed in a direction in which it is moved. The action is independent of either the cross or vertical feeds. This is stressed as making for faster operation, as the table feed is the one most frequently engaged.

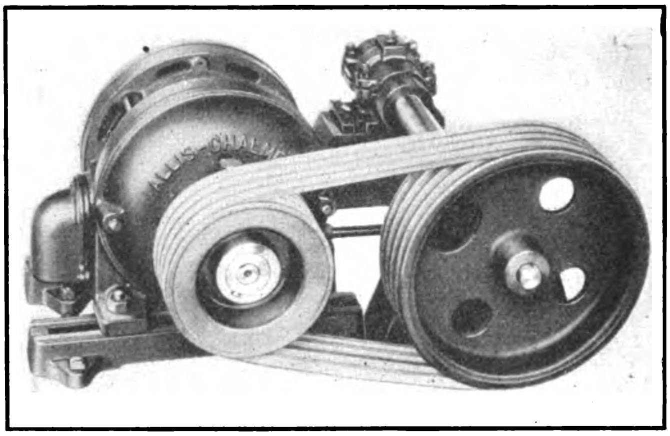
At the front of the saddle on the right-hand side, there is an oil reservoir fitted with tubing which leads to all of the important wearing surfaces in the table and saddle. Prominent location of this reservoir is intended to eliminate all possibility of the operator's failing to lubricate properly any of the vital parts of the saddle mechanism. This new feature, together with automatic flood lubrication for all gears and bearings inside of the column, practically concentrates oiling at but two filling points. All models and sizes, Nos. 1 to 4, of the company's milling machines are now available with enclosed motor-in-base drive.

A flexible short center drive

A NEW type of short center, flexible drive, known as the Texrope drive has recently been placed on the market by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. It can be used on machine tools, fans and blowers, conveyors, etc.

The drive consists of two grooved sheaves and a number of specially constructed endless vee belts. The sheaves are set just far enough apart so that the belts fit the grooves without either tension or slack. Since the Texrope belts just fit the sheaves, there is no appreciable slack or lost motion in the drive. Because of the vee construction, the belts cannot slip, as the harder the pull the more firmly the belts grip the grooves. As the belts are elastic they act as cushions between the driving and driven machines and do not transmit vibrations. Bearing pressures are low, since no initial belt tension is employed. The drive occupies very little space. It is silent, clean and is said to be unaffected by moisture or dirt. Since there is no appreciable slip, the speed ratios are constant.

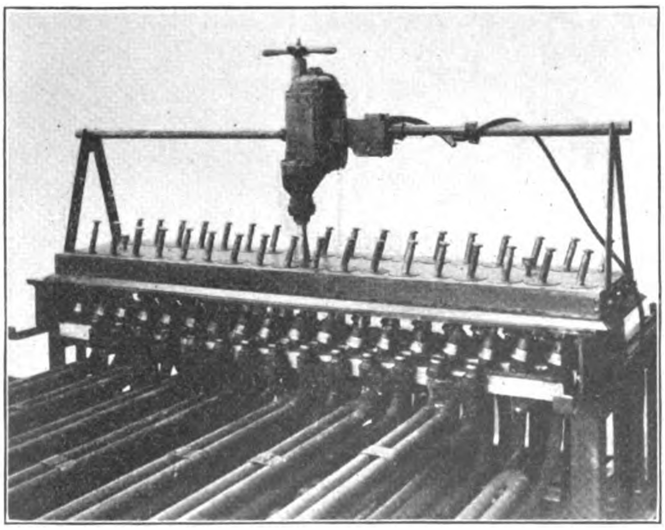
Texrope drives from ½ to 250 hp., with ratios up to 7 to 1 and belt speeds from 800 to 6,000 feet have already been placed in service.



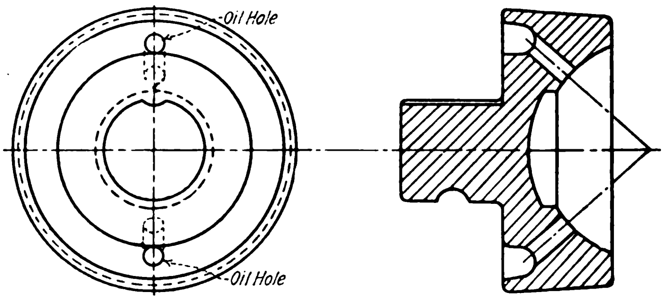
An exhibition model of the Allis Texrope drive manufactured by the Allis-Chalmers Manufacturing Company

Superheater unit joint grinder

A MULTIPLE spindle tool designed to grind two rows of superheater unit joints, totalling as many as 36 joints, simultaneously, has been developed at the Beech Grove shops of the Big Four and placed on the market by the Transportation Devices Corporation, Indianapolis, Ind. The construction of the tool will be evident from an examination of the illustrations which show a front view of the machine in operation and also with the grinding spindles lifted and the machine head rolled back for inspection of the joints. The spindles, all driven through enclosed gears from one motor, have a gyratory movement, and one of the important advantages of the tool is that this movement is more uniform and hence tends to produce a more uniformly satisfactory joint than one ground by hand. A bad fitting joint is



Front view of the superheater unit joint grinder grinding 36 ball joints at one time

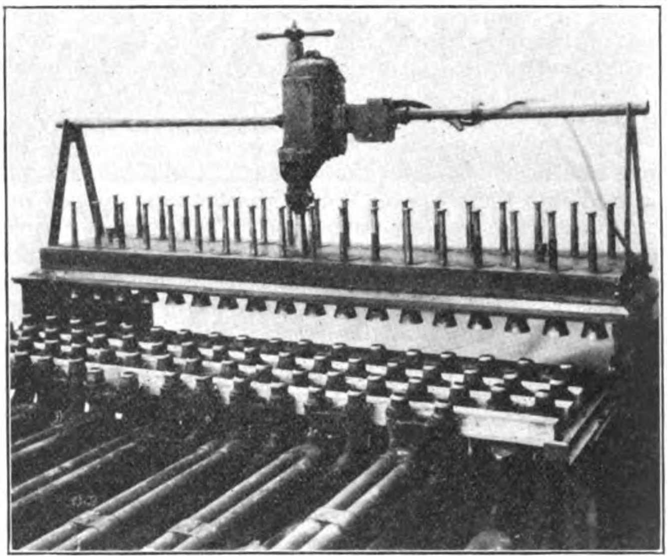


The special grinding lap head has a recess at the top of the cup and an annular groove with two feed holes to the grinding surface

difficult to repair after the superheater is applied to the locomotive.

Special grinding lap heads are provided with a recess at the apex of each cup which prevents bottoming on the joint. This construction also tends to maintain the correct contour, thereby prolonging the life of the lap head. Grinding compound is placed in an annular groove on the top of each lap head, feeding automatically through two holes to the inside grinding surface. It is not necessary to stop the machine to apply grinding compound to the annular grooves or lift the lap heads, for the compound to feed to the surfaces being ground. The machine is therefore automatic in operation requiring only an occasional inspection after the set-up to determine when the joints have been ground sufficiently. This feature is important in obtaining efficient production.

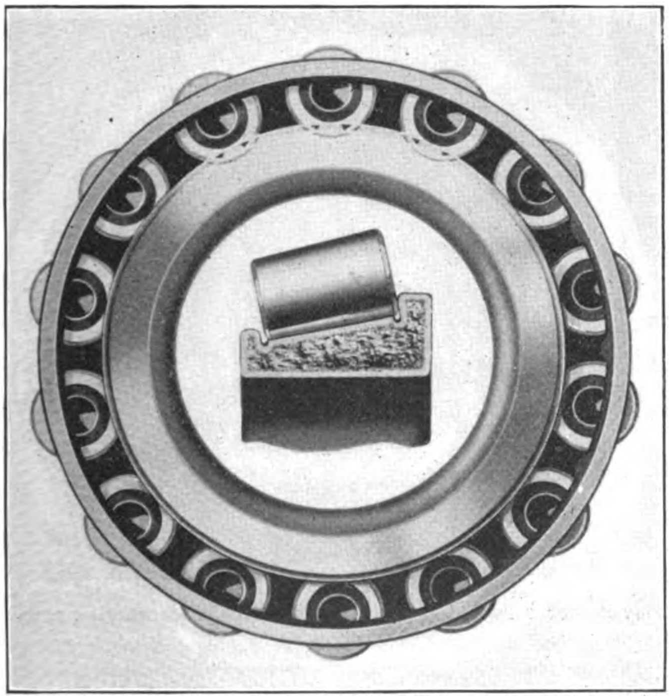
In operation the superheater units are given necessary repairs and assembled in the grinder in the same relative positions as occupied in the locomotive. No bolts or clamping devices are necessary to hold the units, their weight being sufficient to keep them in place. The only supporting equipment required consists of metallic longitudinal spacers built into the machine, and wooden cross spacers to maintain the proper center distances. When the grinding operation is completed the entire set of units is lifted out of the grinder by a crane and delivered to the desired location in the shop, thus eliminating considerable extra handling.



Grinding spindles lifted and the machine head rolled back for inspection of the joints

Improved tapered Timken roller bearings

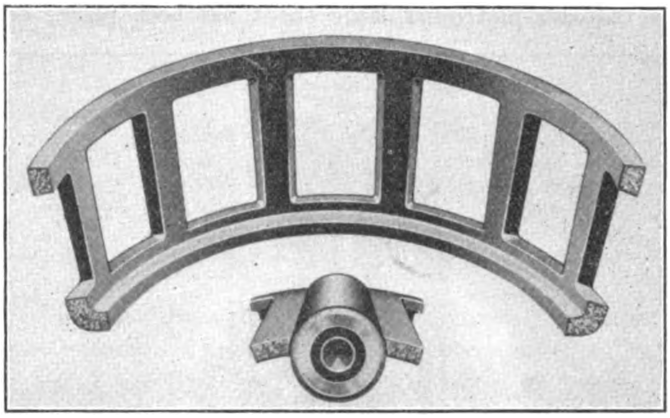
An improved type of Timken tapered roller bearing, differing from the older type in major refinements but retaining all the original essential elements, has recently been placed on the market by the Timken Roller Bearing Company, Canton, Ohio. These bearings are particularly adapted to rail and motor truck service.



The bearing between the end of the Timken roller and the cone flange is in two areas, shown in phantom at the top of the illustration

Nickel-molybdenum steel, of special Timken formula has been adopted for all bearings. The inclusion of nickel and molybdenum produces a steel possessing properties of grain texture, toughness, hardening, heat treating and machining which tend to increase the life of antifriction bearings.

Varied refinements in the bearing itself are noteworthy. The design of the roll has been changed so that the surface of the large end presents a right angle relation to the center line of the roll. The contact between the large end of the roll and the rib of the cone is in two areas. The rib of the cone is slightly undercut. This two-area contact insures perfect axial alinement between the center line of the roll and the center line of the bearing at all times. Likewise, there is always absolute line contact between the surface of the roll and the surface of the cone, and between the surface of the roll and the surface of the cup.



Improved Timken roller cage showing inwardly turned flange which prevents stretching of metal when stamping out bearing pockets

An added purpose served by the two-area contact is self-alinement of the rolls on the cone in the cup without

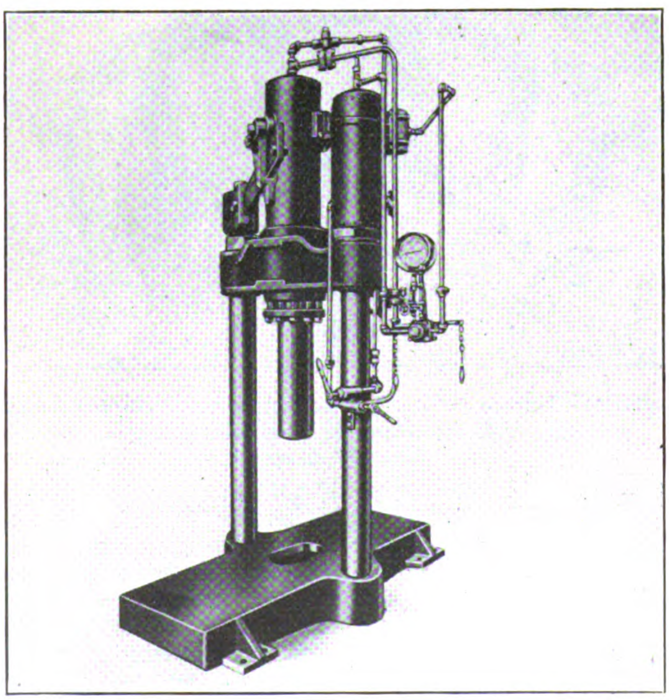
resorting to a cage fixture to retain the alinement. The primary purpose served by the cage is to retain the spacing of the rolls about the cone and to make the cone with its set of rollers a unit assembly. The skewing of the roll on the cone raceway is impossible, since the two areas on the end of the roll make generously separated points of contact with the shoulder or rib of the cone, as shown in the illustration.

The Timken cage has been improved along with the cone and roller assembly. Previously, the cage was cold pressed into the shape of a cup, the bottom stamped out and the pockets for the rolls punched out, one at a time, by an automatic punch press. The result of this single stamping operation was positive uniformity of cage pockets, but there was a progressive error in alinement, due to the stretching of the metal as the indexing fixture advanced the metal cage to the final perforation. To correct this microscopic error, a multiple perforating die was developed which perforates all roll pockets in the cage, by a single impact. To further safeguard against any possibility of error due to distortion during this operation an inwardly turned flange has been retained on the smaller side of the cage. To insure smoothness and a perfect fit of the rollers in the cage, the lateral edges of the cage are swedged inward so that the contour of the sides of the cage pocket conform to the contour of the roll. Dies similar to the multiple perforator are used, so that all cage pockets are winged simultaneously. The inwardly turned flange and the result of the winging operation are shown in the illustration.

With the advent of more quietly running parts in certain machine installations, the Timken Company has kept pace by reducing the noise in the bearing to a marked degree by the self-alining principle and perforated cage.

Two rod hydro-pneumatic forcing press

A PRESS designed for operations involving forcing, pressing and bending, and adaptable more especially to railroads and other large shops has been placed on the market by the Watson-Stillman Company, New York. This press not only provides means for the rapid and convenient pressing in and out of bushings, driving box brasses and pressing of gears on and off of shafts, but because of its long bottom platen or base it can be used for many operations of bending and straightening.



Watson-Stillman hydro-pneumatic 100-ton capacity forcing press

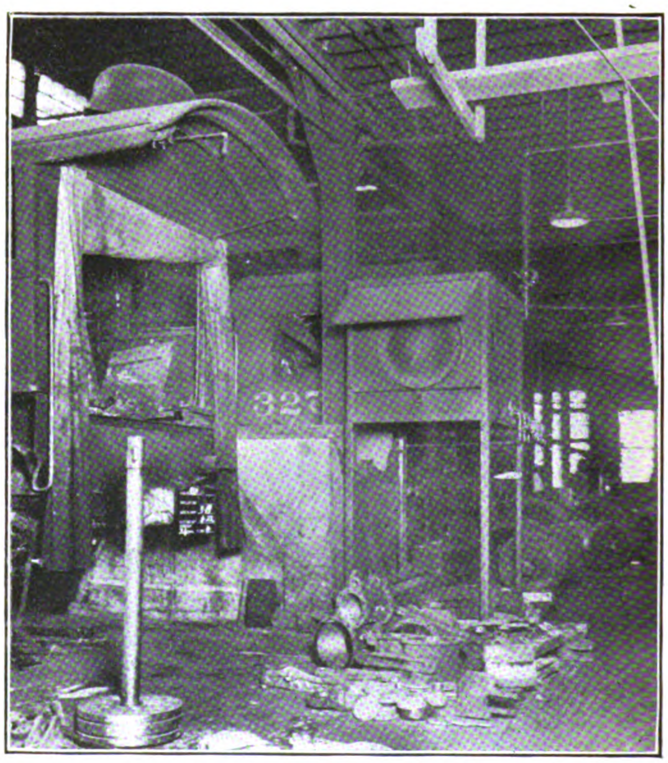
The press is of the two rod type having the ram movement from the top downward. The ram movement is actuated by hydro-pneumatic force obtained by an air engine pump which is designed to be connected to the air line of the shop. Thus, it will be seen that the press can be operated in any shop having air pressure and does not require a motor or any other source of power.

A jib crane is provided as part of the press to facilitate handling work into and out of the press. The bottom platen is amply strong for bending with blocks on its ends up to the full capacity of the press.

The valve control is simple and easily operated and a gage is provided to register in tons the pressure exerted by the ram. The press illustrated is of 100 tons capacity and bottom platen is 72 in. long with a hole in the center to receive shafts, etc.

Unit heater for railroad shops

THE unit heater recently developed by the ILG Electrical Ventilating Company, Chicago, is a cabinet open at both ends in which is housed heating coils for steam or hot water and a self cooled motor propelled fan. This cabinet serves as a heating chamber for the air which is drawn in over the heated coils on the intake side at low velocity—about 500 ft. per minute and discharged in volume at high velocity at about 200 ft. per minute. The heaters are intended for shops, factories and warehouses and similar localities and it is claimed for them that they effect a considerable saving in fuel as well as greater rapidity in warming up the buildings.



Unit heater installed in New York Central locomotive repair shop

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

THE CHICAGO, BURLINGTON & QUINCY is now using its new Denver shops for the repair of all its locomotives used in Colorado, Montana, Wyoming and western Nebraska. Heretofore this work has been done at Havelock, Neb. The force, when the arrangements are complete, will call for 300 additional men, the present number employed being 700. All repair work for the Colorado & Southern is also being done in this shop.

THE NEW LOCOMOTIVE REPAIR SHOPS of the Mobile & Ohio at Jackson, Tennessee, known as the "Iselin Shops," were formally opened by Fairfax Harrison, president, and E. E. Norris, vice-president of the road, on December 1, 1925. These shops were built by Dwight P. Robinson & Company and consist of a main locomotive repair shop of the transverse type, having fifteen pits; a storehouse and office building; and, in addition, a wheel shop and a power house.

American Railway Association elects new directors

J. M. Davis, president of the Delaware, Lackawanna & Western Railroad, has been elected a member of the board of directors of the American Railway Association, to succeed W. H. Truesdale, chairman of the board of managers of that company, resigned. Fairfax Harrison, president of the Southern Railway System, has been elected to fill the vacancy caused by the death of Julius Kruttschnitt, chairman, executive committee, Southern Pacific Company.

New cars and locomotives

Class I railroads during the first eleven months of 1925 placed in service 123,858 freight cars, according to reports filed with the car service division of the American Railway Association. This was 24,973 cars less than the number installed during the corresponding period of 1924 and 53,987 less than during the same period in 1923. The total placed in service in November was 4,615, including 1,726 box, 1,975 coal and 395 refrigerator cars. Freight cars on order on December 1 totaled 27,721, as compared with 45,095 on the same date in 1924 and 36,789 in 1923.

Class I railroads during the first eleven months in 1925 placed in service, 1,604 steam locomotives, compared with 1,951 during the same period in 1924 and 3,704 during the corresponding period in 1923. The same roads on December 1 had 339 locomotives on order, compared with 265 on the same date in 1924 and 739 two years ago. During the month of November 112 locomotives were installed in service.

These figures as to freight cars and locomotives include new, rebuilt and leased equipment.

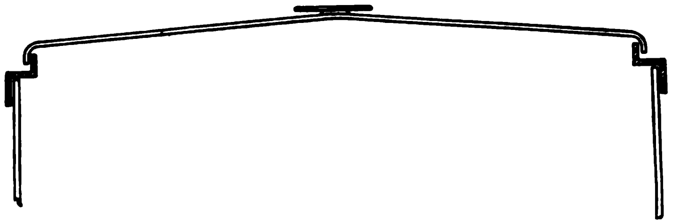
Mechanical division adopts standard double sheathed wood sheathed box cars

Two designs of double sheathed, wood sheathed standard box cars presented at the annual meeting of the Mechanical division of the American Railway Association by the Committee on Car Construction have been submitted to letter ballot and adopted by an overwhelming majority of the membership. Members numbering 313 and representing 2,450,755 cars owned or controlled, voted in favor of the proposed standard designs, with seven members representing 46,830 cars opposing, and 89 members representing 250,452 cars not voting. The results of this letter ballot are given in Circular D. V.-434. In addition to the adoption of standard car designs, the association has approved as recommended practice specifications for side frames and bolsters, coupler yokes and hatch plugs for refrigerator cars as recommended by the committee. The minimum wheel seat diameter of axle with 4½-in. by 8-in. journals is increased to 5¾ in., and the total load for car and lading established at 116,000 lb., this change requiring an amendment to the Interchange Rules of the Division which is approved, effective January 1, 1926. The proposition to withdraw the present bolster drawings shown in the manual and substitute the new bolsters shown with the standard car drawings is approved, effective March 1, 1926.

The results of five other letter ballots recently submitted to members of the Mechanical division have been tabulated and published in Circulars D. V.-429, relating to brakes and brake equipment; D. V.-430, couplers; D. V.-431, specifications for tests for materials; D. V.-432, wheels; and D. V.-433, loading rules. In each case the recommendations of the committees in their reports at the June meeting at Chicago were adopted by large majorities.

A. R. A. purchases Williams' car patent

The American Railway Association has acquired the rights to the patent of William Erastus Williams, No. 1,237,434, dated August 21, 1917, which, among other things, covers car roof construction involving the use of a Z-bar side plate so arranged that the Z-bar, in addition to being a connection between the roof and side members of the car, forms a part of the water shedding surface of the roof. In its Circular No. 2569, dated December 1, the association states that "All railroads in the United States and



Arrangement of z-bar side plate and roof

all railroads in Canada and Mexico having lines running into the United States, car owners operating in the United States, and car manufacturing companies may use the construction covered by this patent free from any royalty or payment of any kind."

The patent is held by H. J. Forster, secretary of the association, as trustee for the benefit of the American Railway Association.

Hearing on "Recurrent Acknowledgment" requirement of train control specifications

A hearing was held before Examiner Mullen of the Interstate Commerce Commission at Washington on December 14, with respect to the interpretation placed by Division 1 of the commission upon paragraph 2b, under "Functions" of the specifications and requirements for automatic train-stop or train-control devices. The interpretation, which several of the roads have asked the commission to withdraw, is that "Consistent practice requires definite action by the engineman at each signal indicating stop." W. M. Jeffers, general manager of the Union Pacific, said that operating officers do not feel that the additional requirement of recurrent acknowledgment is necessary and they do feel that it is to some extent objectionable. He said he feared there is a disposition to go too far in assuming that the engineman is not going to be alert, and that the biggest mistake the commission or the railroads could make would be to "get the enginemen in a frame of mind to expect that a device is going to take care of them." A. H. McKeen, signal engineer of the Union Pacific, gave more detailed testimony. J. E. Saunders, signal engineer of the Delaware, Lackawanna &

Western, and H. H. Shepard, general superintendent of that road, also testified. Other roads which have installed or are now installing the Union Switch & Signal Company's device, similar to that on the Union Pacific, asked leave to adopt the testimony without introducing additional cumulative evidence.

Labor Union co-operation

An unusual type of meeting will be held in the auditorium of the Engineering Societies Building in New York City on Friday, February 5, at 8:15 p. m. A joint meeting of the Taylor Society and of the Metropolitan Section and Management Division of the American Society of Mechanical Engineers, with the New York Railroad Club co-operating, will consider "The Labor Union—Management Co-operation in the Railway Industry. A Case Presentation of Effort Towards Stabilization."

Otto S. Beyer, Jr., consulting engineer, widely known as the adviser to the shop crafts labor unions on the Baltimore & Ohio and the Canadian National Railways, will speak on "The Technique of Co-operation." Bird M. Jewell, president of the Railway Employees' Department of the American Federation of Labor, will address the meeting on "Labor's Appraisal of Principles, Methods and Results." Sir Henry Worth Thornton, chairman of the board of directors and president of the Canadian National Railways, will make an address on "Management's Appraisal of Principles, Methods and Results."

Many equipment orders placed for 1926

The Pacific Fruit Express Company has been authorized by its owner companies, the Southern Pacific and the Union Pacific, to purchase 5,000 refrigerator cars to be delivered before September 1, 1926, and in addition to build 41 cars to replace cars retired from service during the past year. The acquisition of this number of additional units will make available for the Pacific Fruit Express 38,375 refrigerator cars, an increase of 15 per cent. The purchase entails an additional investment of almost $16,000,000.

The Baltimore & Ohio has ordered 25 Santa Fe type locomotives from the Lima Locomotive Works, and 25 Santa Fe type from the Baldwin Locomotive Works.

The Atlantic Coast Line has ordered 300 hopper cars and 525 box cars from the Pressed Steel Car Company; 100 ballast cars from the Virginia Bridge & Iron Company; and 30 express cars, 25 coaches, 10 combination passenger and baggage cars, 5 combination baggage and mail cars, and 2 postal cars from the Pullman Car & Manufacturing Corp.

The Delaware, Lackawanna & Western has ordered 35 express cars from the American Car & Foundry Company, and 50 ballast cars from the Rodger Ballast Car Company.

The Lehigh Valley has ordered 500 steel sheathed automobile box cars of 50 tons' capacity from the American Car & Foundry Company; 500 steel hopper cars of 70 tons' capacity and 100 drop end gondola cars of 70 tons' capacity, from the Bethlehem Steel Company.

The Louisville & Nashville has ordered 1,000 gondola cars of 50 tons' capacity from the Pressed Steel Car Company.

The Chicago & Northwestern has ordered 250 Hart improved ballast and work cars from the Rodger Ballast Car Company.

The Seaboard Air Line has ordered 40 Mikado and 10 Mountain type locomotives from the Baldwin Locomotive Works.

The Long Island has ordered 20 steel suburban coaches for steam line service from the American Car & Foundry Company.

The Norfolk & Western has ordered 43 all-steel passenger train cars from the Bethlehem Shipbuilding Corporation.

The New York, New Haven & Hartford has ordered 6 dining cars from the Pullman Car & Manufacturing Corporation, and 5 73-ft. combination passenger and baggage gas-electric cars from the J. G. Brill Company.

The St. Louis-San Francisco has ordered 10 Mountain type and 15 Mikado type locomotives from the Baldwin Locomotive Works.

The Wabash has ordered 1,000 automobile box cars from the American Car & Foundry Company, 300 from the Streator Car Company, and 700 from the Standard Steel Car Company; 20 baggage cars from the American Car & Foundry Company, and 25 eight-wheel switching locomotives from the Lima Locomotive Works.

The Atchison, Topeka & Santa Fe has ordered 850 general service gondola cars from the American Car & Foundry Company; 500 furniture cars from the Pullman Car & Manufacturing Corporation; 500 box cars from the General American Car Company; 500 refrigerator cars from the American Car & Foundry Company; 500 refrigerator cars from the Pullman Car & Manufacturing Corporation, and 15 Santa Fe type locomotives from the Baldwin Locomotive Works.

The Erie has ordered 6 through line coaches and 50 suburban coaches from the Standard Steel Car Company.

The North Western Refrigerator Line has ordered 200 refrigerator cars of 40 tons' capacity from the American Car & Foundry Company.

The Reading has ordered 500 gondola cars of 70 tons' capacity from the Bethlehem Steel Company, 250 from the Pressed Steel Car Company, and 250 from the Standard Steel Car Company.

The Illinois Central has ordered 400 automobile cars from the American Car & Foundry Co. and 400 from the Pullman Car & Manufacturing Co.

The Union Refrigerator Transit Company has ordered 400 refrigerator cars from the American Car & Foundry Company and will build 200 refrigerator cars in its own shops.

The Conley Tank Car Company has ordered 200 tank cars from the American Car & Foundry Company.

The Pittsburgh & West Virginia has ordered 400 steel and 300 composite gondola cars from the Pressed Steel Car Company and 300 gondola cars from the Canton Car Company.

The Missouri Pacific has ordered 15 eight-wheel switching locomotives from the Lima Locomotive Works; and 5 Pacific type and 10 Mikado type locomotives for service on the International-Great Northern and the Gulf Coast Lines, from the American Locomotive Company. The Pacific type locomotives will have 27-in. by 28-in. cylinders, and a total weight in working order of 301,000 lb., and the Mikado type locomotives will have 27-in. by 32-in. cylinders, and a total weight in working order of 340,000 lb.

The Kansas City, Mexico & Orient will construct 50 box cars in its own shops.

New York Central places large orders for new equipment

The New York Central has placed orders for the following new equipment, to cost approximately $11,500,000:

Locomotives

American Locomotive Company:
- 10 Electric for service in New York territory.
- 1 Diesel-electric engine* for passenger service McIntosh & Seymour Corporation.
- 1 Diesel-electric engine* for freight service.

Freight Cars

Standard Steel Car Company:
- 500 Automobile box, 55 tons' capacity.

Pressed Steel Car Company:
- 500 Hopper, 55 tons' capacity.

Ralston Steel Car Company:
- 550 Hopper, 55 tons' capacity.

Passenger Cars

American Car & Foundry Company:
- 40 Coaches for the N. Y. C.
- 15 Baggage for the M. C.
- 10 Baggage for the P. & L. E.

Pressed Steel Car Company:
- 4 Passenger and baggage for the N. Y. C.
- 35 Coaches for the N. Y. C.
- 15 Coaches for the P. & L. E.
- 2 Passenger and baggage for the M. C.
- 3 Passenger and baggage for the C. C. C. & St. L.

Pullman Car & Manufacturing Corporation:
- 20 Coaches for the C. C. C. & St. L.
- 2 Dining for the C. C. C. & St. L.
- 15 Coaches for the M. C.
- 3 Dining for the M. C.
- 15 Dining for the N. Y. C.

Standard Steel Car Company:
- 32 Baggage and mail for the N. Y. C.

Osgood Bradley Car Company:
- 25 Coaches for the N. Y. C.

Merchants Despatch Transportation Company:
- 20 Milk for the N. Y. C.

Company shops:
- 18 Baggage for the N. Y. C.

* These two Diesel engines are the first oil-electric road engines purchased by any railroad in the United States.

N. & W. improvements at Williamson, W. Va.

The Norfolk & Western is planning additions and improvements to its terminal facilities at Williamson, W. Va., as follows:

A 23-stall brick roundhouse, 130 ft. long.
A machine and smith shop of brick and steel, 95 ft. by 125 ft.
A two-story fireproof brick and concrete storehouse, 50 ft. by 100 ft.
An arch brick house of wood and corrugated iron, 36 ft. by 60 ft.
A wash and locker room of brick, 20 ft. by 70 ft.
A two-story brick office building, 50 ft. by 75 ft.
A fireproof brick and concrete oilhouse, 50 ft. by 75 ft.
A 100-ft. inspection pit of concrete.
Concrete extensions to the ash hoist.
A trainmen's lavatory, 28 ft. by 45 ft.
An electric repair shop of brick, 30 ft. by 40 ft.
Three ash hoists of concrete and steel.
Two concrete inspection pits 100 ft. long.
Two engine washing platforms, one a two-track platform.
An electric welding shop, 20 ft. by 30 ft.
An electric motor repair house, 110 ft. by 150 ft.
A pipe and tin shop, carpenter shop and stoker room, 25 ft. by 100 ft.
Track scales of 200 tons' capacity.
An icing station with a double platform 400 ft. long; a crusher house 48 ft. long; a platform 185 ft. long and an ice storage house 125 ft. long.

The estimated cost of this work is about $800,000.

In addition, 11 stalls are being added to the existing roundhouse to take care of repairs to heavier locomotives with 16,000 gal. tanks which have been used since the completion of the second track on the Big Sandy Line. This work involves an expenditure estimated at more than $69,000.

Meetings and Conventions

A. S. M. E. Railroad Division elects officers

THE AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-ninth annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N. J., on June 21-25, 1926. The executive committee is considering the possibility of holding the 1927 annual meeting at some place other than at Atlantic City and has appointed a committee to canvass other locations and report its recommendations.

The following have been elected members of the Executive Committee of the Railroad Division of the American Society of Mechanical Engineers for 1926: Henry B. Oatley, vice-president, Superheater Company, New York (chairman); A. F. Stuebing, chief engineer, Bradford Corporation, New York; R. S. McConnell, Baldwin Locomotive Works, Philadelphia, Pa.; Wm. Elmer, superintendent Middle division, Pennsylvania, Altoona, Pa.; C. E. Chambers, superintendent of motive power and equipment, Central of New Jersey, Jersey City, N. J.; A. E. Ostrander, American Car & Foundry Company, New York; Eliot Sumner, superintendent of motive power, Pennsylvania, New York. Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, New York, is secretary.

At the present time 413 members of the A. S. M. E. are enrolled in the Railroad Division. This number, however, does not include all of the members of the society who are interested in railroad work. In order to make the list as complete as possible, and also to extend the service of the Railroad Division to all members engaged in railroad work and allied industries, it is requested that those who have not already had their names enrolled as members of the Railroad Division do so at once.

Over 3,000 attend New York Railroad Club dinner

The New York Railroad Club held its annual dinner at the Hotel Commodore, New York, on December 17. The dinner celebrated the fifty-second anniversary of the club. Approximately 3,000 members and guests were in attendance.

W. F. Jones, general storekeeper of the New York Central, West Albany, N. Y., the president of the club, served as toastmaster. The principal speaker of the evening was Dr. Charles Alexander Richmond, president of Union College, Schenectady, N. Y. The subject of his address was "Fellowship"; it was a plea for better human relations, not only in industry but nationally and internationally as well.

An elaborate program of entertainment was provided, which included songs and humorous sketches by a group of entertainers and a serio-comic address by "Senator" Ford, the humorous speaker. A special feature of the program was the moving picture "close-ups" of "Our Presidents," which included not only prominent railway executives from Eastern territory, but leaders in the railroad supply industry and other prominent members of the club as well. Moving pictures were also shown of athletic events held by various railroads in recent months.

Decorations were elaborate and the railroad theme was carried in them throughout. Entrances to the ball-room of the hotel where the banquet was served were made to resemble station platform gates—half exact replicas of those in Grand Central Terminal, New York, and the other half similarly accurate reproductions of the gates, with train announcers and all, of the Pennsylvania station. Hotel employees were garbed as dining car waiters, red cap porters, gatemen and trainmen. On each table with the standard which bore the table number was a trainman's lantern, alight, with a red or green globe. Over the speaker's table was a New York Railroad Club banner with dates in the form of an electric sign, on either side of which a silken American flag in a spotlight's glare waved in an artificial breeze from an invisible source.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4-6, New Orleans, La.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, January 12. Paper on Air Transportation will be read by Lt.-Col. Scott Williams, manager, traction department, Mussens, Ltd., Montreal. Moving pictures and slides.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting January 14. Annual dinner in evening.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting February 9.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland. Next meeting February 1. Discussion of 1926 A. R. A. Rules.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting January 14. Motive power department night.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 11.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Sherwin Williams Company will construct a three-story addition to its plant at Chicago.

Mudge & Co., Chicago, have been appointed western representatives for the Graham-White Sander Corporation, Roanoke, Va.

The Railway Motors Corporation, De Pere, Wis., has succeeded to the railway department of the Oneida Manufacturing Company, Green Bay, Wis.

James M. Buick, vice-president of the American Car & Foundry Company, at his own request has been relieved from the management of the sales department, a responsibility assumed six years ago. Mr. Buick, who has been connected with the company in an official capacity since its formation in 1899, will continue as vice-president, with headquarters in New York as heretofore. Herbert W. Wolff, who has been a vice-president since February, 1916, in charge of the Chicago district, has been appointed also manager of sales, succeeding Mr. Buick, and will be located in New York. Mr. Wolff was born on December 27, 1873, and was educated in the public schools of Detroit, Mich. He began his business career with the Michigan Car Company at Detroit in 1886 and when the Michigan and Peninsular car companies were merged in 1892 under the name of the Michigan Peninsular Car Company, he remained in the service of the consolidated corporation. Mr. Wolff was assistant mechanical engineer of this company in 1899 when the American Car & Foundry Company was formed and went to St. Louis, Mo., to become chief mechanical engineer of the new company. He was appointed assistant to the vice-president, with headquarters at St. Louis in 1912 and since 1916 has been vice-president in charge of the Chicago district.

H. W. Wolff

W. J. Henry has been appointed district manager of the Harnischfeger Corporation, Milwaukee, Wis., with headquarters at Charlotte, N. C.

H. A. Brinsley has been appointed service engineer of the Paige & Jones Chemical Company, railroad department, with headquarters at Ft. Wayne, Ind.

J A. Hamilton, representative of the Kerite Company, with headquarters at Chicago, has been transferred to New York, to succeed Percy Miller.

John E. Ferry, assistant to the president of the Franklin Railway Oil Company, Franklin, Pa., has been elected vice-president, with headquarters at Franklin.

Thomas O'Brien, for the past fifteen years engineer and sales manager for the John F. Allen Company, New York, has resigned to go into business for himself.

The General Electric Company has purchased 155 acres of land in St. Louis, Mo., at Birch street and Goodfellow avenue, upon which it plans to construct a plant.

The Interstate Car & Foundry Company, Indianapolis, Ind., has been incorporated to take over the business of the Interstate Car Company, of that city, under lease.

H. C. Haight, treasurer and general manager of the American Forge & Machine Company, Canton, Ohio, has been elected president, and will be succeeded by H. L. Barnes.

George L. Kippenberger, assistant to the vice-president of the St. Louis Car Company, St. Louis, Mo., has been promoted to vice-president and assistant general manager.

The Globe Steel Tubes Company, Chicago, has moved its Chicago office from the Peoples Gas building to Rooms 516 and 517 Wrigley building, 400 North Michigan avenue.

The Worthington Pump & Machinery Company, Cincinnati, Ohio, has awarded a contract to the H. K. Ferguson Company, Cleveland, Ohio, for a 115 by 140-ft. addition to its plant.

The Niles-Bement-Pond Company has sold its Pond works at Plainfield, N. J., and the tools, formerly built at Plainfield, will in future be built at the Niles Tool Works, Hamilton, Ohio.

The Independent Pneumatic Tool Company, Chicago, has opened a branch sales office and service station at 1103 Genesee building, Buffalo, N. Y., and has appointed Joseph P. Fletcher manager.

The name of Harry Vissering & Co., Chicago, has been changed to the Viloco Railway Equipment Company, Inc., following the sale of the entire interest held by Harry Vissering last February.

Ray A. Sossong, manager of gas plants, Air Reduction Sales Company, New York,, was elected president of the International Acetylene Association, at the recent annual convention in Chicago.

A. O. Norton, Inc., Boston, Mass., has opened an office at 2838 Grand Central Terminal, in charge of H. J. Wilson; and another at 421 Chestnut street, Philadelphia, in charge of O. L. Wright.

The Bonney Forge & Tool Works, Allentown, Pa., manufacturer of chrome vanadium drop-forged wrenches, has broken ground for an addition to its plant. The new building will be 110 ft. by 200 ft.

The Massachusetts Mohair Plush Company, Boston, Mass., has increased the territory of Midgley & Borrowdale, Chicago, to now cover the railroads in the whole western territory, west of Pittsburgh.

Frank W. Lampton has been appointed sales representative ot the Hunt-Spiller Manufacturing Corporation, Boston, Mass., and will be located in the southwest territory. Mr. Lampton was born at Fort Scott, Kan., in 1890 and was educated in the public schools of that town, also in the Windsor Business College. He entered the employ of the St. Louis-San Francisco about 1907 as a machinist apprentice. After serving as a machinist on that road for about ten years, he became master mechanic of the Arcadia Coal & Mining Company. In August, 1920, he was appointed general foreman of the St. Louis & San Francisco at Wichita, Kan., later being transferred to Thayer, Mo. In November, 1922, he was appointed general foreman of the South Springfield Terminal, from which position he resigned to become a representative of the Hunt-Spiller Manufacturing Corporation.

Frank W. Lampton

The Morton Manufacturing Company, Chicago, has purchased the property adjacent to its present plant and is planning the construction of an addition which will provide 50,000 sq. ft. of additional shop space.

The Oneida Machinery Company, Oneida, Tenn., has awarded a contract for the construction of a new machine shop to the Austin Company, Cleveland, Ohio. The new unit will be a one-story, steel frame structure, 75 ft. by 142 ft.

The Yale & Towne Manufacturing Company, Stamford, Conn., has bought the Miller Lock Company, of Philadelphia, Pa., and it is to be operated in the future as the Miller Lock Works of the Yale & Towne Manufacturing Company.

George H. Criss has been appointed manager of the H. E. McCoy Company, Pittsburgh, Pa., who are sales representatives in western Pennsylvania and West Virginia, for The Baker-Raulang Company, Cleveland, Ohio, builder of industrial tractors and trucks.

Many additions are being made to the plant of the Ludlum Steel Company at Watervliet, N. Y. The capacity of the billet grinding department has been doubled and a modern exhaust system installed for the elimination of the dust incidental to all grinding operations.

J. N. Walker has been appointed general sales manager of the Oxweld Acetylene Company, New York; L. D. Burnett has been appointed eastern department sales manager, to succeed Mr. Walker, and Z T. Davis, Jr., is now assistant sales manager, eastern department.

Joseph C. McCune, engineer of the Eastern district of the Westinghouse Air Brake Company, has been appointed assistant director of engineering, with headquarters at Wilmerding, Pa. Mr. McCune was born in January, 1890, at Brilliant, Ohio. In 1906 he entered Washington and Jefferson College. He received the first Sibley prize for scholarship at Cornell and graduated from the university in 1911 with the degree of mechanical engineer. From July, 1911, to February, 1912, he was employed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and from the latter date until March, 1913, served with the Pittsburgh Railways Company. He then became assistant to the chief engineer of the Westinghouse Air Brake Company, and in May, 1915, mechanical expert, New York office, serving also on the Mexican border with the 7th Regiment, New York National Guard. From May, 1917, until August, 1919, he was 1st Lieutenant, Engineers of the United States Army, ten months of his service being in France. In September, 1919, he returned to the Westinghouse Air Brake Company as a special engineer at Wilmerding; in January, 1920, was promoted to assistant to district engineer; in October, 1920, became assistant district engineer, and in January, 1922, was appointed district engineer, with headquarters at New York. Mr. McCune is a junior member of the American Society of Mechanical Engineers, holding membership also in the Society of Automotive Engineers, the Air Brake Association, the Traveling Engineers' Association, etc.

Joseph C. McCune

The Baker R & L Company, Cleveland, Ohio, has changed its corporate name to The Baker-Raulang Company. The company manufactures electric industrial material handling tractors and trucks, under the Baker name, and also closed bodies for automobiles, under the name of Raulang.

The Standard Steel Car Company, Pittsburgh, Pa., has purchased the Siems-Stembel Company, St. Paul, Minn.; there will be no changes in personnel. P. C. Stembel, vice-president, will be in charge of the company's activities at St. Paul, and will represent the Standard Steel Car Company.

H. A. Watkins has been appointed metropolitan district sales manager for the Bridgeport Brass Company, with office in the Pershing Square building, New York City. Mr. Watkins was formerly superintendent of docks at New York City. He served as a major of engineers during the late war.

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has opened a district office at Lima, Peru, in charge of W. G. Bolton. C. E. Phillips, representative of the company at Philadelphia, Pa., has been transferred to Wilkes-Barre, Pa. Mr. Phillips will be in charge of the Wilkes-Barre office.

T. D. Owler has been appointed Chicago railway sales representative of the Heywood-Wakefield Company, Wakefield, Mass. Mr. Owler has served for some time with Edward Buker, whom he succeeds as Chicago railway sales representative, Mr. Buker having resigned to go into business on his own account, effective January 1.

The Charles R. Long, Jr., Company, Louisville, Ky., has purchased a tract of land at Sixteenth and Hill streets, upon which it will construct a new plant and lacquer plant, to cost $450,000. The construction will be started immediately, the first unit to be four stories with basement, 70 ft. by 120 ft., and of reinforced concrete.

J. H. Ainsworth, railroad representative of the A. M. Byers Company, Pittsburgh, Pa., has been appointed director of railroad sales, with headquarters at Pittsburgh, and C. W. Damberg, formerly resident inspector of the New York, New Haven & Hartford, has been appointed railroad representative, with headquarters at New York.

The Russell-Burdsall-Ward Bolt & Nut Corporation, Rochester, N. Y., has awarded a contract for the design and construction of a wire mill at its Rock Falls, Ill., plant, to the Austin Company, Cleveland, Ohio. The new mill will be a one-story steel frame building, 85 by 160 ft., and will contain approximately 80 tons of structural steel.

W. J. Nugent, vice-president and general manager of the Nugent Steel Castings Company, Chicago, has been elected president of that company and Prentiss Coonley has been elected vice-president. Mr. Nugent entered the employ of the company in 1918 as vice-president, which position he held until 1921 when he became vice-president and general manager.

W. E. Hedgcock, assistant vice-president in charge of sales of the American Car & Foundry Company, at New York, has been elected a vice-president with duties as formerly. Oscar B. Cintas, vice-president of the American Car & Foundry Export Company, at New York, has been elected also as a vice-president of the American Car & Foundry Company.

Andrew Fletcher, president of the American Locomotive Company, died of heart disease on November 29 at his home in New York City. Mr. Fletcher came from a long line of shipbuilders of Scotch ancestry and was born in New York City on June 8, 1864. He was educated at the College of the City of New York, later studying naval architecture and marine engineering. Among the many important contributions that he made to American marine engine manufacture was his production of the first three turbine-driven vessels launched in the United States. The first was the Governor Cobb, followed by the Yale and the Harvard, fast boats operating between New York and Boston. It was Mr. Fletcher who changed the old side-wheel fashion for ferryboats, driving the boats with two propellers, one at each end. Later he added a further improvement, the double-compound Fletcher engine, which was stipulated as necessary by the New York Central when it placed a recent order for ferryboats.

Andrew Fletcher

Mr. Fletcher after serving as a director and a member of the executive committee of the American Locomotive Company for several years, was in December, 1916, elected as president, succeeding Waldo H. Marshall. He was also a director in the American Car & Foundry Company; American Locomotive Sales Corporation, of which he was president; Atlantic Gulf & West Indies Steamship Lines; Atlantic Gulf Corporation; Bucyrus Company; the Canadian Car & Foundry Company; Consolidated Iron Works, of which he was president; B. B. & R. Knight, Inc.; Lloyd's Register of Shipping for the United States; Montreal Locomotive Works, Ltd., of which he also was president; the Superheater Company; W. & W. Fletcher & Co. (North River

Iron Works); William Cramp & Sons Ship & Engine Building Company; Richmond Locomotive Works, of which he was also president; and the North River Derrick Company. He was a member of the executive committee of the Atlantic Gulf & West Indies Company and a trustee of the American Surety Company. He was also a member of the Society of Naval Architects and Marine Engineers, American Society of Mechanical Engineers, American Society of Naval Engineers and the Institution of Engineers and Shipbuilders, Scotland.

C. L. Wood, assistant general manager of sales of the Carnegie Steel Company, Pittsburgh, Pa., has been appointed general manager of sales, to succeed William G. Clyde, recently appointed president of the company. Samuel R. Hoover has been appointed assistant general manager of sales in charge of the bureau of bars and hoops, to succeed Mr. Wood.

William H. Woodin, president of the American Car & Foundry Company, has been elected also president of the American Locomotive Company, succeeding Andrew Fletcher, deceased. Mr. Woodin has been a director and member of the executive committee of the American Locomotive Company for many years. He is one of the largest individual stockholders of the company, in addition to which the American Car & Foundry Company has also large holdings in America Locomotive Company stock. Mr. Woodin was born at Berwick, Pa., May 27, 1868. He received a technical education at Columbia University, School of Mines, which he attended in the class of 1890. He served in the shops of the Jackson & Woodin Manufacturing Company at Berwick, and in 1892 was made general superintendent of that plant. In 1895 he was elected vice-president and in 1899 president. When the company was taken over by the American Car & Foundry Company in 1899 he was appointed district manager of the Berwick plant. He later became assistant to the first vice-president of the new company, then in 1902 he was made a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, and on February 1, 1916, he succeeded to the presidency. As noted above, he has also been a director and member of the executive committee of the American Locomotive Company. He is chairman of the board of the Canadian Car & Foundry Company and a director of the American Exchange Securities Corporation, the American Beet Sugar Company, the Westinghouse Electric & Manufacturing Company, the Montreal Locomotive Works, the Westinghouse Electric International Company, the General Motors Corporation, the Cuba Company, the Cuba Railroad Company, the Compañia Cubana and the American Ship & Commerce Corporation.

W. H. Woodin

Clyde L. Jones has joined the sales force at St. Louis of the Reading Iron Company, Reading, Pa. Mr. Jones' headquarters are at 1819 Railway Exchange building, St. Louis, Mo. He has a wide experience in the pipe consuming field, having served in a similar position with the Interstate Pipe Company, from which company he resigned to go to the Reading Iron Company.

William V. Griffin, of the Anthony N. Brady estate, and Fred Allison, engineer of the Ford Motor Company, were elected directors at a recent meeting of the board of directors of the American Brown, Boveri Electric Corporation, New York. Laurence R. Wilder, president of the company, announced that it had taken over the Moloney Electrical Company, of St. Louis, Mo., manufacturer of transformers.

L. Wechsler now represents the Canton Foundry & Machine Company, Canton, Ohio, as general eastern sales manager of its New York City office at 203 East Fifteenth street, for the sale of its alligator shears, portable floor cranes and industrial turntables. Mr. Wechsler recently severed his connections as sales manager of the New York office of the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio.

The Oil Jack Company, Inc., New York, manufacturers of the Pedersen Oiljak, has appointed Fred D. Sweet manager of the middle western territory, with offices in the Wrigley building, Chicago, and the Charles M. Hoffman Company, Kansas City, Mo., as its representative in the southwestern district. The Oiljak is based on a new application of principles for lifting and is available in 10, 6, 3 and 1-ton capacities.

The American Brake Beam Manufacturers' Export Association, of West Nyack, N. Y., has filed papers under the export trade act (Webb-Pomerene law) with the Federal Trade Commission, for the purpose of exporting brake beams and parts pertaining thereto. The officers are R. H. Ripley, president; A. C. Moore, vice-president, and F. W. Edmunds, secretary-treasurer. Member companies are the American Steel Foundries and the Chicago Railway Equipment Company, both of Chicago.

H. E. Anderson, district manager of S. F. Bowser & Co., Inc., with headquarters at New York, has been promoted to manager of the northeastern division, with headquarters at Albany, N. Y., and will be succeeded by E. M. Harshbarger, manager of railroad sales, with headquarters at Fort Wayne, Ind. G. J. Komarek, chief sales correspondent in the lubrication and filtration division, with headquarters at Fort Wayne, Ind., has been promoted to district manager, with headquarters at Oklahoma City, Okla.

Henry D. Carlton, vice-president of Manning, Maxwell & Moore, Inc., New York, formerly in charge of the steam specialties department, has now assumed charge also of machine and crane sales. Joseph Wainwright, formerly eastern sales manager of the machinery department, has been appointed general sales manager of the machinery department with jurisdiction over all district offices. Thomas S. Stephens has been appointed manager of railroad sales of the machinery department and William D. Clarke has been appointed general sales manager of the crane department.

George P. Baldwin, general merchandising manager of the General Electric Company, Schenectady, N. Y., has been elected a vice-president. He will have charge of activities connected with the electrification of steam railroads and such other duties as may be assigned to him by the president. His new headquarters are at 120 Broadway, New York City. Charles E. Patterson, vice-president in charge of finance since 1920, is now vice-president in charge of all merchandising activities of the company, including the supervision of company supply houses. He will have his headquarters at Bridgeport, Conn. The accounting department responsibilities of Mr. Patterson have been assumed by the controller, S. L. Whitestone. Henry C. Houck, assistant general merchandise manager, has been appointed manager of the merchandise department of the Bridgeport works. George P. Baldwin was born in San Francisco, Cal., on January 22, 1874. He graduated from Leland Stanford University in 1896 with the A.B. degree. The following year he entered the employ of the Stanley Electric Manufacturing Company, which in 1903 was bought by the General Electric Company. At that time, Mr. Baldwin became vice-president of the Blaisdell Company of Los Angeles, where he remained until March 16, 1910, when he was made manager of the Pittsburgh office of the General Electric Company. On December 16, 1915, he was made manager of the Atlantic district, with headquarters at Philadelphia, Pa. When the merchandising department was created in 1923, he was made its first manager.

George P. Baldwin

Trade Publications

AIR COMPRESSORS.—Duplex single stage and two-stage cross-compound air compressors, Class DB and DE, are described and illustrated in a 16-page bulletin, Form No. 126, which has been issued by the Pennsylvania Pump & Compressor Company, Easton, Pa.

WELDING SUPPLIES.—The Lincoln Electric Company, Cleveland, Ohio, has issued a new catalogue dealing with welding supplies, including cables, glass, shields, welding electrodes, aprons, gloves, brushes, and other accessories needed for repair, structural or production jobs.

SPLICES AND TAPES.—"Splices and Tapes for Rubber Insulated Wires" is the title of a 16-page booklet issued by the Okonite Company, Passaic, N. J. The importance of a perfect splice; the important properties of tape; how to recognize these properties and how to make a perfect splice are the features described in this booklet.

SCREW MACHINES.—Specifications for plain, wire feed and automatic screw machines, attachments and tools are given in catalogue No. 24G issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. The catalogue contains 140 illustrated pages and briefly outlines the development of the screw machine, also the manufacturing methods of the Brown & Sharpe Company.

ENGINEERING ACHIEVEMENTS.—Manuscript No. A-02458, descriptive of its engineering achievements for the year 1925, has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The developments cover equipment for the generation and distribution of power; steam turbines, condensers and stokers; heavy railway traction; radio, and miscellaneous achievements.

STEAM TURBINES.—Steam turbines rated at 500, 600 and 750 kw. are described in Bulletin GEA-235 issued by the General Electric Company, Schenectady, N. Y. The general principles and advantages of steam turbines are discussed, and section and steam path diagrams shown. The type D-54 turbine for the driving of centrifugal pumps, blowers and other classes of mechanical drive, is described in Bulletin GEA-197.

STEAM CONNECTIONS.—The Gold Car Heating & Lighting Company, Brooklyn, N. Y., has issued Bulletin No. 30 covering its 2-in. steam connections for the removal of the 1½-in. choke from between cars, giving a full 2-in. flow from the locomotive to rear end of train, including end valve, hose and fittings and steam hose coupler, which coupler, although of 2-in. size, will couple and lock with the 1½-in. couplers now in use, increasing the weight of the coupler but 14 oz.

MATERIALS HANDLING.—The Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has issued Circular 7378 showing the results to be obtained in the various industries through the use of electrically-driven machinery for the handling of materials. Information and data covering the principal groups of materials handling machines and a description of the electrical devices developed by the Westinghouse Company for materials handling equipment, are contained in the circular.

INDUSTRIAL CONTROL CATALOGUE.—An industrial control catalogue of 160 pages has been issued by the General Electric Company, Schenectady, N. Y., furnishing information on its representative lines of industrial control and including a reprint of the industrial control section of its general catalogue; instructive matter on the care and operation of control devices; wiring diagrams of some standard controllers, push buttons and other accessories; reference tables; lists of publications, and other useful information.

"CONCENTRATION IN BOILERS."—This is the title of a 28-page bulletin, covering the methods and procedure in oil burner testing wherever the burners are fired under boilers or in warm air heating plants, which has just been issued by the American Oil Burner Association, New York. The bulletin discusses such theoretical considerations as are needed for the practical application of the methods and procedure given, which apply for both industrial and domestic burners. One of the principal purposes of preparing the bulletin was to provide under one cover all the important tables and formulas needed in testing burners, thus eliminating the usual annoyance and loss of time due to having to use a number of handbooks or references.

PATENTS.—The third edition of "Patents, Law and Practice" has been issued by Richards & Geier, patent and trade-mark attorneys, 277 Broadway, New York, and is available to manufacturers and those generally interested in the subject of inventions and their proper and adequate protection. Both United States and foreign patents are covered, information being given as to who may obtain patents, what may be patented, how to apply for a patent, the procedure followed in the patent office, interferences, reissues, appeals, infringements, etc. The charges for various services in connection with the preparation of the patent are given in schedule form.

GENERAL ELECTRIC PRODUCTS.—Catalogue 6001B, superseding all previous catalogues issued by the company, with the exception of those dealing with railway, mine and industrial supplies and merchandise products, is being distributed by the General Electric Company, Schenectady, N. Y. The book contains more than 1,100 pages and is thumb-indexed into sixteen sections as follows: Generation, wire and cable, distribution transformers, arresters, voltage regulators, switchboards and accessories, meters, instruments, motors, motor applications, industrial heating, miscellaneous and indexes. In the indexes products are classified both by subjects and by catalogue numbers.

BOILER TUBES.—The first half of Catalogue BT, issued by the Bethlehem Steel Company, Bethlehem, Pa., describes and illustrates the old-fashioned hand knobbling process for making pure charcoal iron for boiler tubes and gives a brief history of iron making and its connection with charcoal iron boiler tubes. The second half of the catalogue is devoted to the testing, inspection, weights and list prices of Bethlehem charcoal tubes, and covers the specifications for lap welded charcoal iron boiler tubes as issued by the American Society for Testing Materials, the American Society of Mechanical Engineers, and the American Railway Association, also the general rules and regulations prescribed by the Board of Supervising Inspectors.

SMALL TOOLS.—The Greenfield Tap & Die Corporation, Greenfield, Mass., has issued Small Tools catalogue No. 49, superseding catalogues Nos. 46A, 46A-2 and all others formerly issued under the names of Wells Brothers Company, Wiley & Russell Mfg. Company, F. E. Wells & Sons Company, A. J. Smart Mfg. Company and the Lincoln Twist Drill Company. Taps and dies, screw plates, twist drills, reamers, screw slotting cutters, gages, pipe tools and bolt threading machines are listed in this catalogue, a thumb index providing easy reference to the individual tools. The gages and bolt and pipe threading machines are listed for the first time in this catalogue of 384 pages. The special method of packing screw plates for domestic trade is also described.

"COMPARISON OF DIESEL ENGINE PRINCIPLES."—This is the title of Bulletin No. 1020 recently issued by Fairbanks, Morse & Co., Chicago. The bulletin is a clear, non-technical exposition of the various principles of operation on which Diesel engines have been developed, in which is set forth the reasons why this company has adopted the two-stroke cycle, airless fuel injection principle in its stationary and marine Diesel engines. In addition to the discussion of the advantages of the two-cycle principle and the airless fuel injection, the bulletin explains the two-stage process of combustion incorporated in Fairbanks-Morse engines, the fuel economy, factors affecting heat dissipation and the speed control and regulation of these engines. The bulletin is thoroughly illustrated with both photographs and diagrams.

INSTRUCTION BOOK ON INTERNAL GRINDING.—The Micro Machine Company, Bettendorf, Ia., has recently issued a simple, concise manual of instructions covering the operation and care of the Micro internal grinder, together with general information on the art of internal grinding. This book is written to assist purchasers of the Micro internal grinder in obtaining the best results from their machines. The book is carefully prepared and comprehensive in character, being divided in general into three sections on grinding wheels, general operating instructions, and locomotive air compressor grinding. Important tables are included to assist in the selection of the proper grinding wheels for cast iron, hardened steel and soft steel grinding. Complete instructions are also included regarding correct speeds and the arrangement of the machine for wet grinding. An important page of "Micro Don'ts" is included in the back part of the book.

Personal Mention

General

F. P. PFAHLER has been appointed assistant to the chief of motive power and equipment of the Seaboard Air Line, with headquarters at Savannah, Ga., a newly created position.

Master Mechanics and Road Foremen

J. H. WEBER has been promoted to assistant road foreman of engines, of the Seaboard Air Line, with headquarters at Tampa, Fla.

R. L. KIRKLAND has been promoted to assistant road foreman of engines of the Seaboard Air Line, with headquarters at Tampa, Fla.

E. R. DOWDY has been appointed assistant master mechanic of the Chesapeake & Ohio, with headquarters at the Fulton shops, Richmond, Va.

H. Y. HARRIS has been appointed master mechanic of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

HARVEY J. MCCRACKEN, whose appointment as master mechanic of the Stockton division of the Southern Pacific, at Tracy, Cal., was announced in the December issue of the *Railway Mechanical Engineer,* was born on October 24, 1873, at Thornton, Cook Co., Ill. He attended the public schools of Thornton and Auburn Park, Ill., entering the service of the Belt Railway of Chicago on October 19, 1891, and serving four years apprenticeship and five years as boilermaker with that company. In November, 1900, he entered the service of the Southern Pacific as a boilermaker at Sacramento, Cal., and in January, 1904, was transferred to Portland, Ore., as foreman boilermaker of the Portland division. In March, 1912, he was appointed district boiler inspector of the Northern District, with headquarters at Portland. In February, 1914, the Northern and Central districts of the Southern Pacific were consolidated, and Mr. McCracken continued as district inspector of the consolidated territory, comprising six northern divisions. In April, 1925, he was appointed assistant master mechanic of the Western division, with headquarters at West Oakland, Cal., where he remained until his appointment as master mechanic of the Stockton division.

H. J. McCracken

H. M. AGIN has been appointed road foreman of engines of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern with headquarters at Waldo, Fla.

R. R. HARRIS has been appointed road foreman of engines of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

C. E. PLOTT, road foreman of engines of the Chicago, Burlington & Quincy, at Centralia, Ill., has been promoted to general roundhouse foreman, with headquarters at Burlington, Iowa.

W. L. LONGSTRETH, assistant road foreman of engines of the Panhandle division of the Pennsylvania, with headquarters at Columbus, O., has been transferred to the Eastern division, with headquarters at Pittsburgh, Pa.

A. B. FORD, general master mechanic of the Central district of the Great Northern, with headquarters at Great Falls, Mont., has been transferred to the Lake and Eastern districts, with headquarters at Duluth, Minn., succeeding T. E. Cannon, who has retired.

Shop and Enginehouse

MICHAEL BRANCH has been appointed tool supervisor of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

A. B. CHAPMAN has been appointed supervisor of welding of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

R. G. FIELDS has been promoted to assistant night roundhouse foreman of the Finley shops of the Southern, with headquarters at Birmingham, Ala.

C. T. BRYANT, gang foreman of the Huntington shops of the Chesapeake & Ohio, has been promoted to general foreman, with headquarters at Peru, Ind.

F. B. DOWNEY, general foreman of the Chesapeake & Ohio at Covington, Ky., has been promoted to general foreman of the Huntington, W. Va., shops.

JAMES M. PLASKITT, mechanical engineer, Finley shops, Southern, Birmingham, Ala., has been appointed night enginehouse foreman, with headquarters at Finley.

F. L. BROWER has been promoted to assistant roundhouse foreman of the Finley shops of the Southern, with headquarters at Birmingham, Ala., succeeding R. G. Fields.

W. R. REIMAN, night roundhouse foreman of the Chicago & Northwestern at Chicago, has been promoted to general roundhouse foreman, with headquarters at Clinton, Iowa.

HARRY F. MARTYR, roundhouse foreman of the Kansas City Terminal, has been appointed general foreman, with headquarters at Kansas City, Mo. Mr. Martyr began his railroad career on the London & Northwestern, England, in 1890, coming to America in September, 1897, and entering the service of the Missouri Pacific at St. Louis. Later he was employed by the Lima Locomotive Works and the Standard Oil Company. Returning to railroad work, he served successively as a machinist, machine shop foreman, roundhouse foreman and general foreman of the Frisco System. In 1907, he became general foreman of the Detroit, Toledo & Ironton at Jackson, Ohio, and in 1911, entered the service of the Rock Island, his last position on that road being general foreman of the locomotive shops at Horton, Kan. In September, 1919, Mr. Martyr was appointed master mechanic of the St. Louis & Hannibal at Hannibal, Mo., and was later employed by the Crandall Packing Company. In February, 1923, he became roundhouse foreman of the Kansas City Terminal. Mr. Martyr is a charter member of the Railway General Foremen's Association, of which organization he has served as treasurer.

Purchasing and Stores

F. C. NEWMAN has been appointed storekeeper of the Southern, with headquarters at Hayne, S. C.

J. H. SMITH, storekeeper of the Southern at Hayne, S. C., has been appointed division storekeeper, with headquarters at Atlanta, Ga., succeeding G. A. Blackwell, deceased.

New firebox is installed in record time at the Burnham shops of the D. & R. G. W.

Railway Mechanical Engineer

Vol. 100 February, 1926 No. 2

College men in the mechanical department

A college education is intended to train young men to think—to think straight—and to develop and strengthen their characters. The railroads need men who are trained to analyze problems and situations in order to determine the real facts, and on the basis of these to suggest remedies or solutions. Some of the more important industries have felt a pressing need for men who could function in this way and have been keen to recruit college-trained men. A very few railroads have made it a business to use college-trained men in the mechanical departments. Unfortunately, few of even these roads have done much to studying the situation scientifically and, after securing college-trained men, to see that they have been developed and utilized to the best advantage. Many railroads make absolutely no effort to attract college men to the service. To a large extent the railroads have handled this problem in a hit-and-miss way and have "muddled" through it. Something should be done to get the railroad representatives and the college professors together to make a very much needed survey and analysis of this situation and to recommend a policy which will more adequately meet the needs. There has been a lot of talk about this question, but too much of it has been in the way of generalities and opinions. What is needed now is some real scientific research and analysis.

Specialization of car repairs

An outstanding example of specialization in freight car heavy repair work is to be found at the Enola car shops of the Pennsylvania at Harrisburg, Pa., the operations of which are described on another page in this issue. At the present time this shop is rebuilding open-top cars of only two classes and at no time has it handled repairs to any but open-top equipment. The opportunities for the development and the installation of special equipment, which tends greatly to increase the productive efficiency of the plant and its personnel, which are offered by this specialization on a limited number of types in large runs, will impress the reader as he studies this article. When methods such as those adopted by the Pennsylvania, however, are suggested as of possible value on smaller systems, with perhaps considerably smaller numbers of cars of similar design, the answer very frequently is "That is all right for a large road, but our road is too small for any such methods." The possibilities of specialization are, of course, much greater on a system of large mileage with large numbers of cars of like design than on smaller railroads. Some of these possibilities, however, are available to every railroad maintaining more than one shop point for making heavy repairs to freight cars and the possibilities for specialization increase with each added heavy repair shop. Indeed, the possibilities are not entirely absent even where only one shop is available with which to work, as a reasonable amount of planning may make it possible to concentrate on rebuilding different series of equipment at different periods. Specialization requires planning. No matter how much local conditions may effect the extent and nature of the final plan, the adoption of some plan for systematic handling of any heavy freight car repair work places the car department officer in control of conditions which otherwise would control him. Only to the extent that he is master of his operations can their efficiency be assured.

What about engine truck lubrication?

Reports, received from numerous sources, indicate that trouble is being experienced in lubricating engine truck bearings, particularly where the locomotive runs have been extended over a number of divisions. The facts of the matter seem to be that the engine truck journals develop high temperatures and that no use of free oil admitted to the journals through the oil holes customarily provided in engine truck boxes seems to help the situation. It has been noticed that the oil apparently leaves the dope in the journal box cellars faster than can be accounted for either by evaporation or leakage at the ends of the cellars, and it is later found distributed well over the engine truck frame with the probability that still more of it is lost to the roadway and track. The normal movement of the oil seems in this case to be reversed due to some sort of a syphoning action, and, the more oil applied to the dope or as free oil, the more there is spread over the engine truck frame. The *Railway Mechanical Engineer* will be glad to publish the views of any of its readers as to the cause of this difficulty in lubricating engine trucks. Explanations of how the difficulty has been overcome will be particularly welcome.

The new labor bill

The past few years have witnessed a marked change on the railroads in the spirit of the relations between the managements and the employees—a change for the good which is little less than remarkable. There are many people who object strongly to the use of the word "co-operation," because it has been abused and misused to such an extent as to have lost much of its meaning in a big, forceful, constructive way. Nevertheless, a real spirit of co-operation in its better and higher sense has found its way into railway organizations, as well as into many of the industries. There are a variety of reasons for this and it may be worth while to consider a few of them.

The world war and the difficult and confusing period which followed it, caused great apprehension as to future developments in the industrial and transportation world,

as well as in our political and social structures. This forced people to think and to make a greater effort to get below the surface and determine the real facts about the situation. Naturally, there is still much loose thinking of the soap-box orator type, but, nevertheless, the average man today is not nearly as susceptible to such appeals as in former years. For one thing, Americanization and citizenship programs have been more actively promoted. Immigration has been restricted and more intelligent attention has been given to the assimilation of the foreign element.

The question of government ownership of the railways, precipitated by the taking over of the railroads by the government during the war and the discussion of ways and means to transfer the roads back to their owners, caused the general public to analyze, if only in a general way, the functioning of the railroads and the vital part which they play in the public welfare. The railway managements, seriously concerned over the outcome, threw themselves into an educational campaign which reached the employees as well as the general public, and dissipated many misunderstandings as the facts about railway management and operation became more widely known and better understood. The shippers saw clearly what unintelligent regulation of the carriers could do in handicapping railway operation, and alarmed at this, went even further, and have shown a cordial and even enthusiastic spirit of constructive co-operation, which has made possible a far greater degree of efficiency in utilizing the railway facilities.

Industrial leaders a few years ago began to awaken to the fact that industries had grown so fast—and the railways likewise—that they had far outstripped improvements in methods of management. For one thing, no adequate plan had been devised to provide for the right kind of leadership and to develop and train the great number of officers, supervisors and foremen which were required. While much still remains to be done in this respect, a start has been made, small as it may be. Even this slight advance has been reflected in the better relations between the workers and the managements.

The Railroad Y. M. C. A. took an advance position two and a half years ago in converting its triennial international conference into a better relations conference, and this has been followed up by a large number of system and local get-together or better relations meetings. A number of roads have inaugurated various types of what might be called personnel activities, extending all the way from the formal organization of a personnel department to the limited application of personnel work in certain specific departments. The formation of supervisors and foremen's clubs and training classes has been speeded up during the past season.

These are only a few of the things that apparently have developed a spirit of co-operation and understanding, which made possible the joining of the railway managements and representatives of the workers in suggesting a labor bill to Congress, which will abolish the present Railway Labor Board and establish machinery for adjusting misunderstandings and disputes.

A summary of the important principles involved in the bill will be found in the news section. Hearings are now being held before a Senate committee in Washington. Naturally both sides had to give up something in agreeing upon this bill and because of these understandings Congress is being asked to pass the bill just as it has been presented. A representative of a manufacturers' organization has asked that certain changes be made in the bill because he believes that it does not adequately protect the public interest. While there may be some merit to his criticisms, it must be remembered that, after all, the important thing in making the bill effective will be the spirit in which the parties attempt to carry out its provisions. Apparently there is now an excellent spirit of co-operation on the part of the managements and men, and this means far more in the interests of all concerned, including the public, than a bill which might look better on paper, but was not fully endorsed or concurred in by the managements and the men. It is quite probable that Congress, recognizing this, will keep its hands off and put it squarely up to the railroads and the employees to abide by the law, when enacted, in the spirit in which they entered into the agreement to recommend it to Congress.

Fuel records and road foremen

The most favorable records in operating efficiency during 1925 were made in gross ton-miles per train hour and gross tons per train but the fuel performance expressed in pounds per thousand gross ton-miles was a close third, showing a decrease of 6.6 per cent in the first ten months of 1925 as compared to a similar period in 1924, and 14.2 per cent over the first ten months of 1923. The intensive effort which many of the railroads have been making to cultivate among employees of all classes a knowledge of how to save fuel and a desire to accomplish this end are thus shown to be bearing valuable fruit. It is readily possible to compute the actual saving in dollars which this reduction in fuel consumption makes possible.

Engine crews cannot be given all of the credit for good locomotive fuel performance, nor should they receive all the blame when the fuel consumption figures are higher than seem to be desirable or necessary. It is self-evident, however, that engine crews are one of the most important factors in the situation and the fact that a steady reduction in the fuel consumption per thousand gross ton-miles is being made proves that the crews are measuring up to their task in no uncertain way. A master mechanic recently reported, "It might interest you to know that frequently I have an engineer call on me, advising that he has hauled 1,600 tons from a given point to V——— with six tons of coal, and asking if I will not figure out the pounds of coal per thousand gross ton miles, as he thinks that he has established a record." Such an attitude as this is impossible unless engine crews feel that they are being treated fairly and are proud of the roads they work for. Master mechanics and road foremen are largely responsible for the morale of the crews.

The idea of competition in fuel performance between divisions and between individual engine crews having comparable runs on the same division may well be encouraged, for it adds greatly to that interest which must be kept fully alive in order to accomplish the best results in fuel economy. The need of close co-operation between both sides of the cab should also be emphasized, for unless both enginemen and firemen study the action of the locomotive on the fire under various operating conditions, fuel will be wasted and tempers tried. Minor defects should be discovered and corrected before they have a chance to develop into something serious and with both the enginemen and firemen working together in harmony the chances of these defects being overlooked are minimized.

That improvements in the method of operating locomotives are still necessary is shown by the following comment of another master mechanic, "There are too many men operating locomotives upon the theory of 'a big locomotive a big noise.' The engineman that creates the biggest noise at the stack is usually anything but successful, and his failure is bound to be detrimental to the general condition and efficiency of the locomotive." The impor-

tance of road foremen in educational and morale building efforts among the engine crews cannot be over-estimated and there is little question that some roads are at the present time operating with too small a force of this important class of supervisor. In general the limits at the present time are about 40 to 100 locomotives per road foreman. Obviously if the railroads which give one road foreman 40 locomotives to look out for are right, the other roads which make a road foreman responsible for 100 locomotives and the crews necessary for their operation are scattering the efforts of this man too widely for his work to be effective.

Savings on repair costs

A correspondent writing on the subject of "Savings on repair costs," said, in a letter published in the January *Railway Mechanical Engineer,* that: "Locomotives are carded in the shop, needing, let us say, a new cylinder, when the parts needed are not on hand. This locomotive cannot be built in the proper time on account of the missing material. . . . The essential contributing factor to such a situation is that locomotives do not receive the proper inspection before coming to the shop with the result that defective parts are not located until the engine is in the shop and stripped.

"Again, under the present methods of accounting, men must charge out their time against some locomotive. As a result of this practice, a locomotive that is in the shop a long time receives an incorrect labor charge, due to the men becoming too familiar with the engine number. To remedy these conditions, I would suggest that a thorough inspection be made of a locomotive about due for the shop and the standard defective parts noted. The report should be forwarded to the shop which is scheduled to make the repairs; the parts obtained and machined as far as possible ready to apply, before the locomotive is ordered in. The locomotive could then be rebuilt rapidly and the time out of service greatly reduced."

This correspondent who signs himself "Schedule Supervisor" has evidently, in the study of his job, come in close contact with one of the factors which tends to disrupt the otherwise smooth operation of a well organized scheduling system, namely; delays due to shortage of material. Primarily, scheduling systems have been introduced to facilitate shop output, but if the possibilities of utilizing them as indicators of future requirements have not been considered, then they have failed to serve their full purpose.

Within the past two years remarkable strides have been made in the development of scheduling systems and in almost every large shop that has installed some form of system one of the outstanding facts has been that the routine operation of such a system has made it necessary to not only know in advance what work is to be done, but what material will be needed to perform that work. Drawing on the experience of one road which has been especially successful in the development of its scheduling system, it may be of interest to comment on the fact that the advisability of establishing close contact between the mechanical and the stores departments soon became apparent. To attain this contact, one man has been assigned to devote his entire time to following up material requirements. He has simplified his work to a great extent by analyzing daily the copies of locomotive work reports which are furnished him from divisional engine terminals. In this way he is continually informed of all defects of any parts on a locomotive which may eventually go to that shop for repairs. The defect is immediately investigated to determine whether or not the part can be repaired or a new part will be required. It may readily be determined about how long it will be before that locomotive is due to be shopped and with this advance notice of material required, there should be no excuse for a shortage of material existing when the locomotive is finally taken into the shop for repairs.

A lack of co-operation between the mechanical and stores departments may be the source of great loss. Possibly one of the reasons, in many cases, why a stores department falls down when it comes to supplying material when most needed is because the mechanical department has failed to furnish proper information far enough in advance of the time that the material is needed to afford the stores department an opportunity to secure it.

New Books

THE MAKING, SHAPING AND TREATING OF STEEL. *By J. M. Camp and C. B. Francis. Published by the Carnegie Steel Co., Bureau of Instruction, Pittsburgh, Pa. Flexible binding, thin bible paper, fabricoid cover,* 5 *in. by* 7¾ *in.* 1194 *pages,* 346 *illustrations,* 104 *tables. Price* $7.50.

This is the fourth edition of this book within six years, and is virtually a new work on the metallurgy of iron and steel. While the previous editions were written mainly as a text and reference book for employees of the Carnegie Steel Company, this edition has been expanded to meet the needs of all the subsidiary companies of the United States Steel Corporation, not only as a text book for use in the various schools conducted by these companies but also as a reference book for their employees. In the work of composition and revision, the authors have kept in mind the needs of the customers of these companies and the schools and colleges throughout the country, among the latter of whom the previous editions have been used to a considerable extent. Consequently, in addition to revising the old text, there has been added much new matter, making the present volume about twice the size of the preceding edition. The book now covers the metallurgy of pig iron, wrought iron, and all kinds of wrought steel, from the mining of the ore and other raw materials to the finished products ready for fabrication, including tool steels, wire, sheets and tubes.

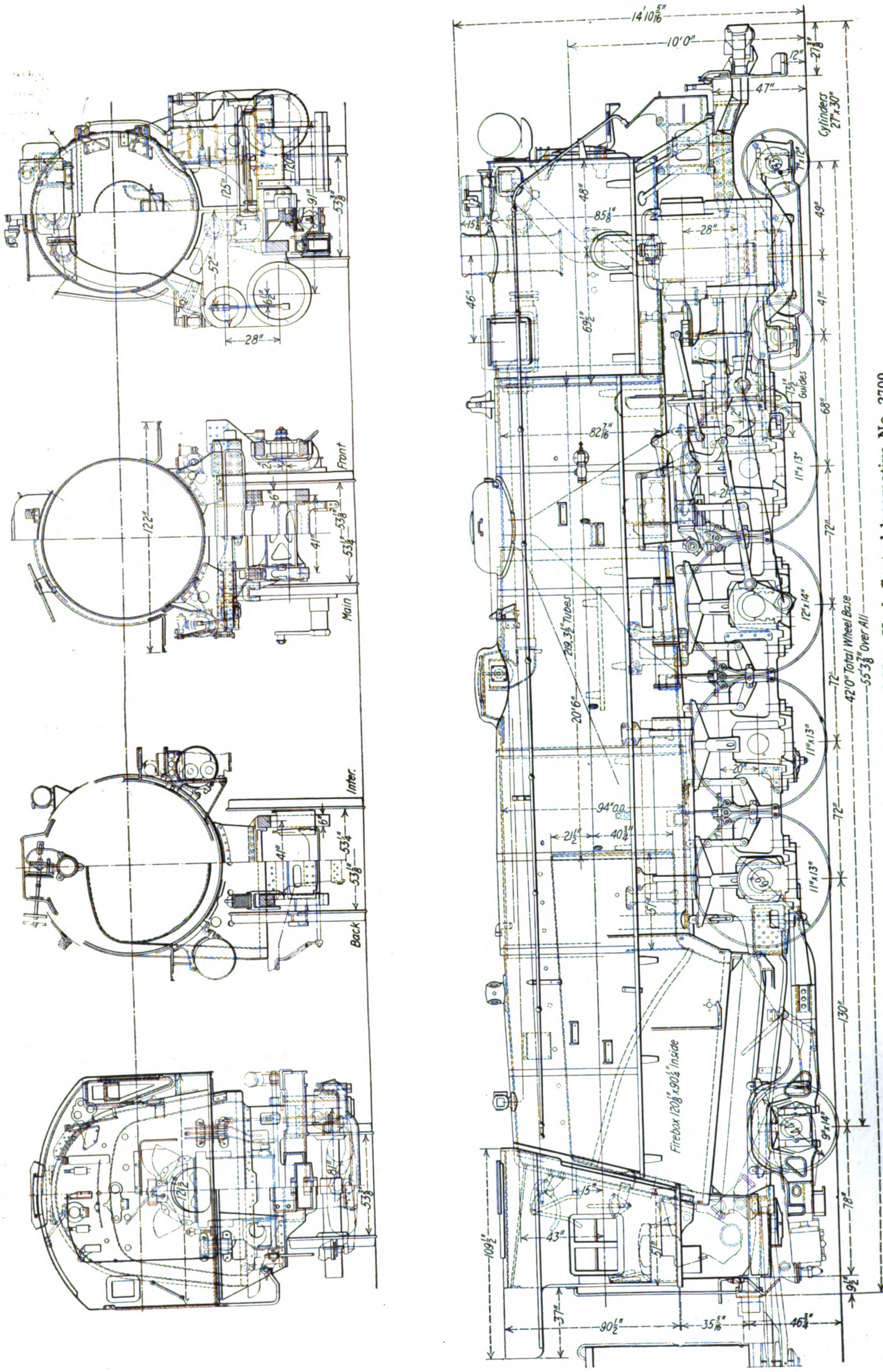
The book is divided into four parts. The first part includes 12 chapters under the general head of The Making of Steel. The new subjects added to Part One in this edition are chapters on The Manufacture of Wrought Iron, the Early Methods of Making Steel and an additional discussion on the acid open hearth process which was added to the chapter entitled, The Open Hearth Processes. Parts of other chapters have been entirely rewritten.

Part Two is entitled The Shaping of Steel and contains a total of 11 chapters. New material on pulverized coal, the by-product process of manufacturing coke, the benzol plant, and the classification of products of ferrous metallurgy, have been added to this part of the book.

"The Constitution, Heat Treatment and Composition of Steel" is the subject of Part Three which contains five chapters. Three new sections have been added to the chapter on Structural Alloy Steels and the last chapter is also a new addition to the book. The sections on Hardening and Tempering in the chapter on Heat Treatment have been entirely rewritten.

Part Four is devoted to The Manufacture of Steel Wire, Sheet and Tubular Products. It contains five chapters, the last chapter of which, on The Manufacture of Steel Tubular Products, is new.

The arrangement of the book makes it a convenient text for either teaching, general reading or reference.

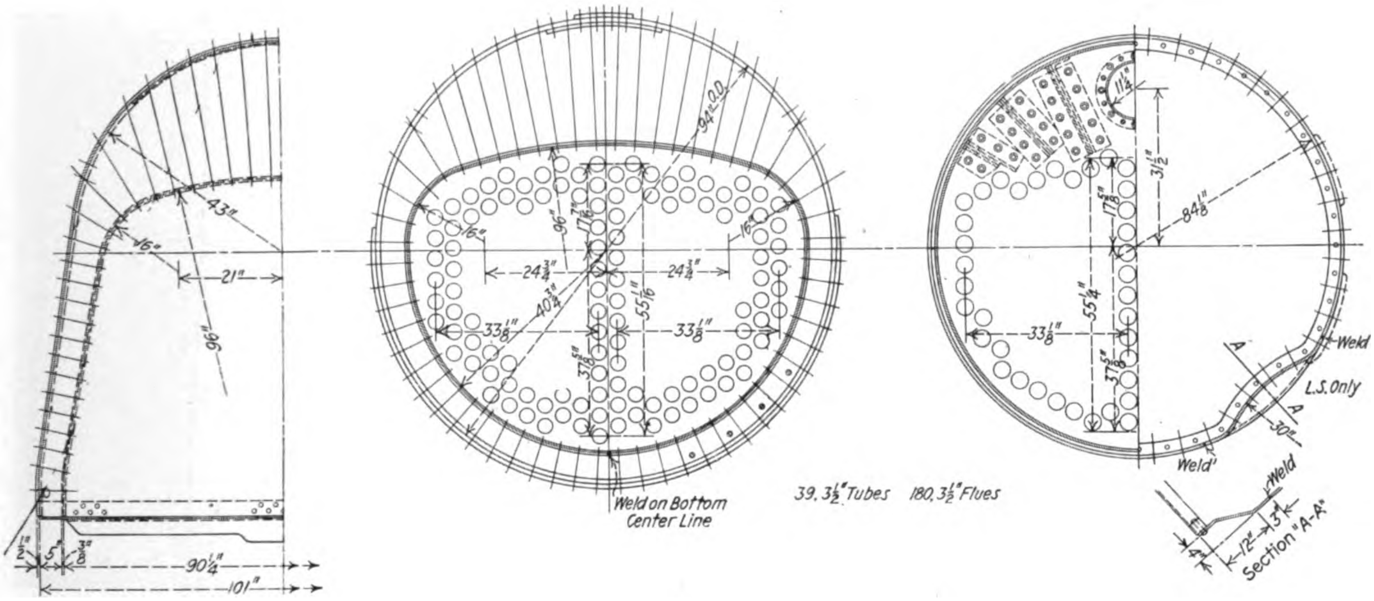


Elevation and cross-section drawings of New York Central locomotive No. 2700

New York Central buys 4-8-2 type locomotives

Location of accessories and construction of engine truck obtain better distribution of weight—Designed for high capacity

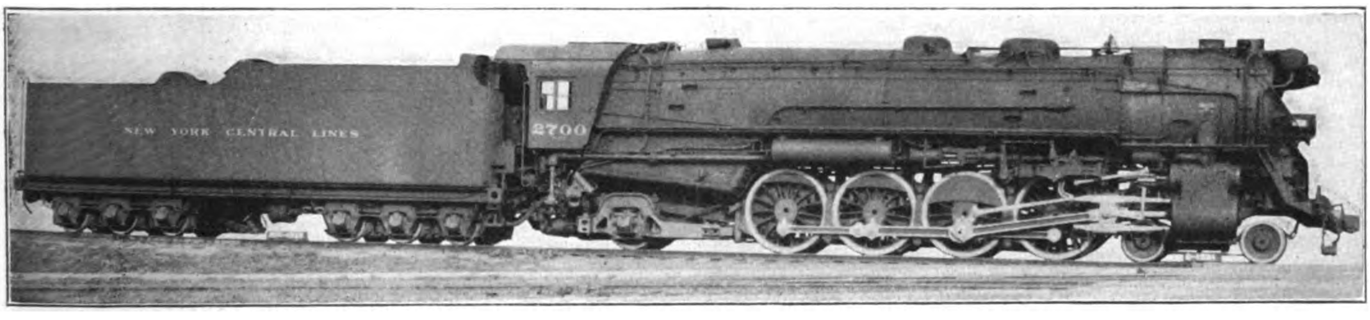
During the past ten months the new York Central has been operating a 4-8-2 type locomotive, built by the American Locomotive Company, in heavy freight service over the Mohawk division between the Selkirk engine terminal, near Albany, N. Y., and the Minoa terminal, located about eight miles east of Syracuse, N. Y. This division is a low grade line, the traffic requirements being such as to demand a locomotive that will maintain a high sustained tractive force at speeds. To meet these conditions locomotive No. 2700 was designed to handle maximum trains over this division at speeds corresponding to traffic requirements. No restrictions were placed by the railroad on the builders in the design of this locomotive, except to use as many New York Central standards as possible and to conform to certain axle loads.



Cross section drawings of the boiler of the 4-8-2 type locomotive

The required maximum sustained horsepower was obtained by the use of a boiler having ample proportions, a firebox of ample heating surface and volume, and the application of the latest design of feedwater heater and superheater, together with the application of a stoker. Driving wheels 69 in. in diameter were used instead of 63 in., as commonly used in freight service, with a view to better meet the requirements of a river grade line. As a result of the performance of locomotive No. 2700, 99 locomotives of similar design have been ordered, making a total of 100 of this type, which will eventually be placed in operation on the New York Central system.

One of the problems in the design of modern locomotives is to secure a satisfactory distribution of the weight over the engine wheel base. Locomotive No. 2700 is equipped with an Elvin stoker and a trailer booster. The location of the Elesco feedwater heater in its customary place on the smokebox front in a measure tends to balance the concentration of weight at the rear end. The location of the two cross-compound air compressors in front of the cylinders and the front end throttle, which is located



Locomotive of the 4-8 2 type built for the New York Central by the American Locomotive Company

in front of the stack, are further aids in improving weight distribution.

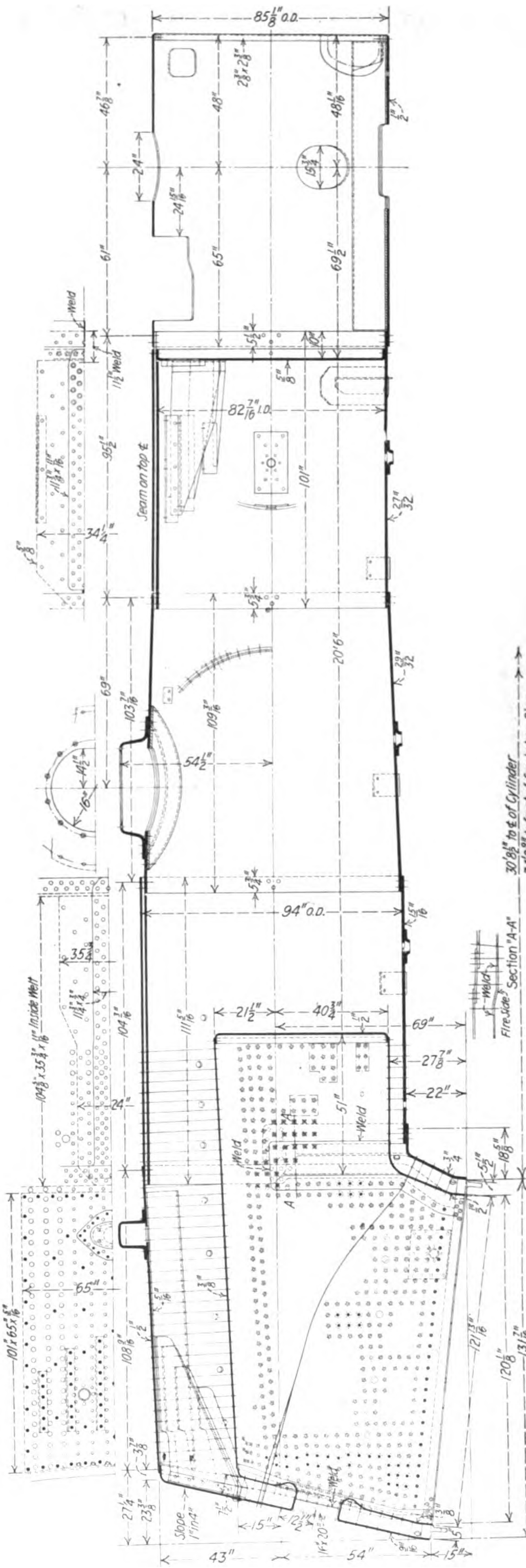
The designers have also assisted in obtaining a more satisfactory weight distribution through the construction of the engine truck. Referring to the elevation drawing, the reader will note that the truck center pin is 2 in. in the rear of the center line of the trucks and also that it is 6 in. back of the transverse center of the cylinders. This arrangement places a greater weight on the rear engine truck wheels than on the front which facilitates the guiding action of the truck and also shifts a greater proportion of the total weight of the engine onto the truck itself.

As shown in the table, these locomotives develop a rated tractive force of 60,000 lb. without the booster. With the booster an additional tractive force of 12,700 lb. is acquired, making a total of 72,700 lb. The total weight of these locomotives is 359,000 lb., of which 240,500 lb. is carried on the drivers, 58,000 lb. on the trailing truck and 60,500 lb. on the engine truck.

The boiler of these locomotives is of conical construction. As stated in a preceding paragraph, the design is of ample proportions which is an important factor in the increased capacity of these locomotives. The area of the grate is 75.3 sq. ft. The heating surface of the firebox and combustion chamber is 320 sq. ft. and the total evaporative heating surface of the boiler is 4,451 sq. ft. The boiler is equipped with a Type E superheater. The total

Principal dimensions, weights and proportions of the New York Central 4-8-2 locomotive

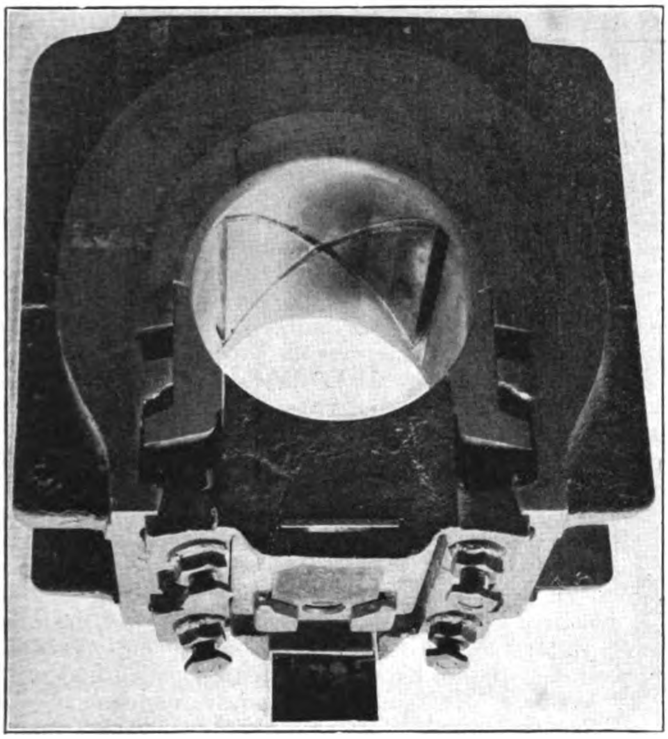
Railroad	New York Central
Builder	American Locomotive Company
Type of locomotive	4-8-2
Service	Fast freight
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	9 in.
Outside lap	1 9/16 in.
Exhaust clearance	0 in.
Lead in full gear, constant	3/16 in.
Weights in working order:	
On drivers	240,500 lb.
On front truck	60,500 lb.
On trailing truck	58,000 lb.
Total engine	359,000 lb.
Tenders	275,000 lb.
Wheel bases:	
Driving	18 ft. 0 in.
Total engine	42 ft. 0 in.
Total engine and tender	84 ft. 7 in.
Wheels, diameter outside tires:	
Driving	69 in.
On front truck	33 in.
Trailing truck	44 in.
Boiler:	
Type	Conical
Steam pressure	225 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	82 7/16 in.
Firebox, length and width	120 1/8 in. by 90 1/4 in.
Combustion chamber, length	51 in.
Tubes, number and diameter	39-3 1/2 in.
Flues, number and diameter	180-3 1/2 in.
Length over tube sheets	20 ft. 6 in.
Grate area	75.3 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	320 sq. ft.
Arch tubes	36 sq. ft.
Tubes and flues	4,095 sq. ft.
Total evaporative	4,451 sq. ft.
Superheating	1,985 sq. ft.
Comb. evaporative and superheating	6,436 sq. ft.
Tender:	
Water capacity	15,000 gals.
Fuel capacity	18 tons
General data estimated:	
Rated tractive force, 85 per cent	60,000 lb.
Rated tractive force, with booster	72,700 lb.
Cylinder horsepower (Cole)	3,640 hp.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	67
Weight on drivers ÷ tractive force	4.02
Total weight engine ÷ comb. heat. surface	55.8
Boiler proportions:	
Tractive force × dia. drivers ÷ comb. heat. surface	645
Firebox heat. surface ÷ grate area	4.25
Firebox heat. surface, per cent of evap. heating surface	7.18
Superheat. surface, per cent of evap. heating surface	4.45



Elevation drawing of the boiler of the New York Central 4-8-2 type locomotive

superheating surface is 1,985 sq. ft., making a total combined evaporative and superheating surface of 6,436 sq. ft. Ready access to the unit bolts of the superheater is provided by a manhole located at the rear of the stack as shown in the elevation drawing. All the flues are of cold drawn, seamless steel, of which there are a total of 219, all 3½ in. in diameter. The pipes from the feedwater heater are placed inside the smokebox which secures a better exterior appearance without greatly lessening the accessibility via the smokebox door.

The cylinders are of cast steel, the use of which material reduces the weight by 2,500 lb. The diameter is 27 in. and the stroke is 30 in. The design of these cylinders follows the usual conventional style of cast iron construction. The valves are of the piston type, size 14 in. and have a maximum travel of 9 in. They are actuated by a Baker valve gear, arranged to give a maximum cutoff of from 82 per cent to 84 per cent. This cutoff has been found to give the most satisfactory results at the relatively high speeds at which this locomotive is operated. The locomotive is equipped with a single exhaust pipe having a 7¼-in. nozzle.



View of main driving box equipped with supplemental bearings

The main driving boxes are equipped with supplemental bearings designed for use on high powered locomotives. An idea of the construction of the boxes can be obtained by referring to the view shown in one of the illustrations. This type of main driving box was originally developed to withstand the severe service encountered in locomotives of three-cylinder design. It will be noted that additional bearing surface is provided below the center line of the journal which tends to eliminate excessive wear at the bottom edges of bearings of the ordinary type used on locomotives.

This engine is equipped with the standard New York Central 12-wheel tender. It has a Commonwealth cast steel frame and six-wheel trucks, equipped with clasp brakes. The tender is also provided with a water scoop in accordance with New York Central practice. The tank is of the water leg type having a capacity of 15,000 gal. of water and 18 tons of coal.

The foreman's job*

By F. M. A'Hearn

Greenville, Pa.

PROBABLY no better understanding can be gained of what the job of a railway shop foreman really is than by reference to our school dictionary where we find that among other definitions of the word foreman, the expression "the chief man." Assuming that the foreman is the *chief man,* it follows that he will of necessity possess certain characteristics that enable him to assume and maintain successful leadership.

Observing the conduct of a successful leader or foreman we see among other personal characteristics honesty, a broad-minded attitude, responsibility, originality, a progressive spirit, and last, but not least, an equal willingness to receive or to give orders or instructions.

The foreman in addition to passing judgment on the work of the mechanics, which requires the use of his own experience gained as a workman, is further trusted with something more important than skill or trade knowledge. He is given authority. No arbitrary time can be set in which a foreman shall learn the proper use of the authority given him. While some men make excellent supervisors from the beginning, others do not do so well. An unjust or incompetent foreman by misusing his authority can undo the efforts of the employer who seeks to promote the contentment and welfare of employees.

New type of foreman

Leadership excepted, the duties of the foreman of today are as unlike those of the past generation as are the tasks of the workman. Such things as pneumatic or electric tools, high speed steel, and the cutting torch, have made no greater change in the work of the mechanic than shop drawings and records, standard practice sheets, apprentice instruction, and time or production studies have in the duties of the foreman. He is not required today to be a traveling encyclopedia of shop information or a demonstrator; his time is too valuable for that. He is to lead, to know what is being done, to know how work should be done, and to get work done. He will correct wrong practices. He is usually the first man to discover frequent failures of parts and should be the first to seek the cause and suggest the remedy. In these matters he will use the same diligence that he would if he were manager of his own business. If the foreman does not display interest in such affairs they usually are not corrected as they escape the notice of his superiors because of lack of intimate knowledge of details and are accepted as being a permanent condition by the workmen having knowledge of their existence—the workman assuming that what is satisfactory to the foreman need not concern them.

The foreman must work in harmony with the heads of other departments, endeavoring to promote the interests of the entire organization, rather than to attempt to handicap other departments in order to reflect credit upon his own. He will listen carefully to suggestions for betterment from the men, showing his appreciation of their interest in their duties, and will apply their suggestions when consistent, not suppressing the identity of the proposer. When suggestions offered are not practicable good judgment must be used in rejecting them; otherwise, the impression may be given that they are not wanted. This tends to discourage future suggestions. Experience has shown that when a mechanic originates a certain tool or change and the improvement is carried out in accordance with his idea, two results are obtained. First, if the me-

* From a contribution entered in the *Railway Mechanical Engineer* competition on the foreman and his responsibilities.

chanic is given the tool to use he will make more of an effort toward its successful operation than if it is the idea of the foreman or another workman. Second, he is encouraged to think of other improvements and naturally takes a greater interest in his work and in the affairs of his employer.

"Least law is the best law"

As the foreman's position is in the nature of a clearing house for the business transactions between the employer and the employee, it must be a well kept and orderly house. His is a constructive and responsible position. His attitude may bring benefit or the opposite to one or both of the parties. His qualifications must be above those required to hire, drive, and fire. No great degree of intelligence is required to dismiss a man from service by one having the authority to do so, but to stimulate interest and make a better workman of an indifferent employee is a work calling for the best that the foreman can bring forth. It is not implied that men should be coaxed to do their work, or that disregard of rules should be tolerated. On the other hand, the old adage, "The least law is the best law," deserves consideration in formulating shop rules.

The value of the product of the hand may be measured by the hourly rate and paid for on that basis, but the interest and loyalty of a body of men may be had at no monetary cost whatever. Tendered in return for what in their estimation is right in the attitude of the management toward them, loyalty and interest among the men are not beyond the reach of any foreman's ambition.

One example of loyalty is shown by the following incident: During the railway shop strike a few years ago, approximately 50 per cent of the men in a certain shop left their work. During the previous winter a group of 30 men had organized a night school class connected with the state vocational educational work and taught by a shop employee. The subject of the course was shop practice. In re-organizing the class the following term it was found in checking names that one single member of the class had left the service, although the members were scattered over several different departments. The fact that these men were sufficiently interested in their work to attend school on their own time showed them to be ambitious men. Their attitude in wishing to render better service by broadening their knowledge of their respective trades showed their loyalty and fair mindedness, afterward proven by their action during the strike. It is significant also that almost without exception each one bought and read the best mechanical magazines obtainable. A foreman may develop or eliminate a spirit of this sort by his attitude or comments. He is looked to by his men as being in a position to judge. Capable and efficient men lighten the labors of the foreman, give a greater return to the employer for the wages paid them, and, most important of all, give themselves a sense of self-reliance, self-respect, and permanency that is reflected in their home lives and families, making better citizens of all.

Suggestions for study

Volumes could be written covering the opportunities of the foreman. This brings to mind "Foremen—Spark Plugs or Grounded Wires," by Sherman Rogers, a work sufficiently appreciated by President Howard of the Commonwealth Steel Company to cause him to present copies to the delegates of Rotary International Convention in St. Louis in 1923.

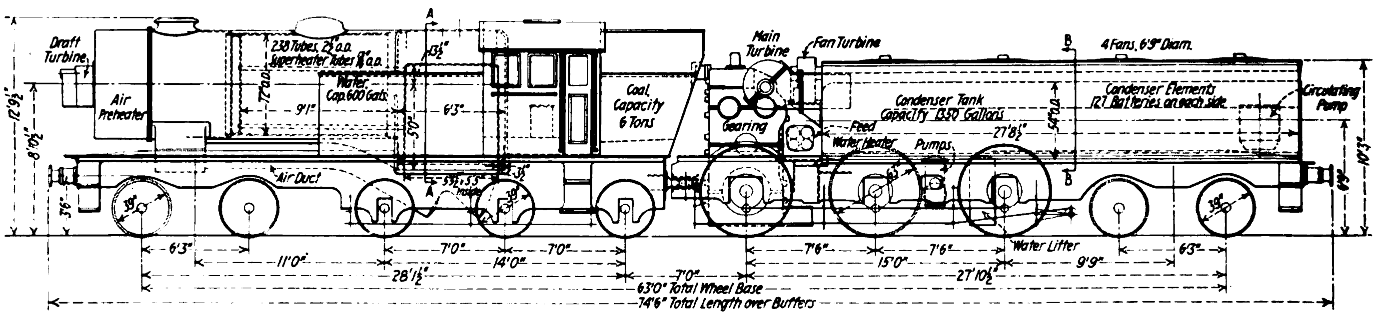
"What's on the Workers' Mind," by Whiting Williams, gives the author's experience covering a period of several months going from job to job as an untrained worker. Other practical books on the subject of management may be had by the foreman having the interest and energy to secure them. He will profit by study of his work.

Whether the foreman of today has been especially trained for his work or whether the foreman of the future is to be trained are matters decided by those above the foreman. The foreman has many opportunities within his reach should he care to grasp them:

First—In the interest of the employer—He can study his work in order to make the best use of the means at his disposal to secure an adequate return for the money expended for labor and material. At the same time he can prevent many unnecessary expenditures for labor and material—in this respect he can save a large amount.

Second—In the interest of the employee—He can make better workmen and better citizens of the men trusted to his guidance. He can train men to fill his place or the places of others when he or they pass onward. He can promote good will—a sympathetic word or a small kindness has a value not measured in dollars and cents.

Third—In his own interest—A man who schools himself to be competent in managing the affairs of others is training himself to manage his own affairs more successfully. His position as a foreman or chief man is an honorable and dignified occupation calling for intelligence and ability of a high order. President Vauclain of Baldwin Locomotive Works and President Chrysler of the Maxwell Motor Company are former railway shop mechanics. The transportation industry of today is a vast and growing business. Its shop management requires men of broader judgment and more general knowledge than is required in the highly specialized manufacturing industries. What better contribution can the railway shop foreman offer in his duty as a citizen than to labor to improve the quality of the commodity we offer the public—transportation.



Elevation drawing of Ljungström turbine condensing locomotive built for experimental purposes on the British railways by Beyer, Peacock & Co., Ltd., Manchester, England

Horsepower, main turbine, 2,000 hp.; boiler pressure, 285 lb. per sq. in.; heating surface of air preheater, 13,500 sq. ft.; cooling surface of condenser, 13,500 sq. ft.; maximum tractive force, 38,000 lb.

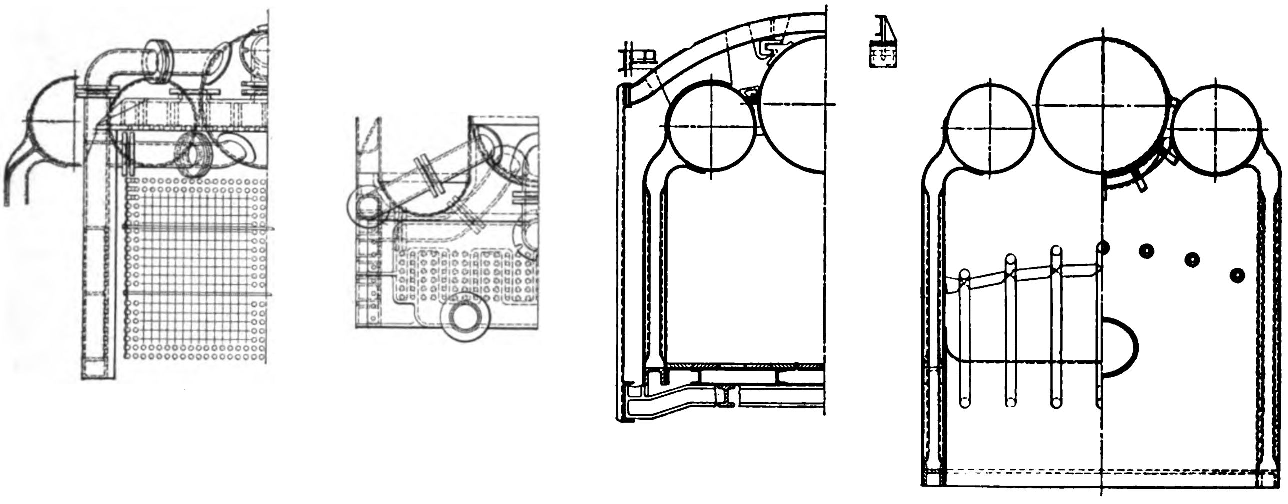
Some suggestions for future locomotive development

Details of boiler construction and its advantages—Side water legs stayed with cable wire

By William A. Newman
Mechanical engineer, Canadian Pacific, Montreal, Que.

Part II

THE boiler itself forms the forward portion of the main locomotive frame; that is, the strength of the boiler structure is made use of partially to support its own weight. A channel side sill will run throughout the length of the locomotive which would be attached at intervals to the body bolsters, serving as ties across the bottom of the boiler, and also serving as center plate supports at the pivoting centers of the forward and rear trucks. The side walls of the water storage space at the rear of the main portion of the locomotive would also be constructed so as to be self supporting, and would be carried forward by structural members and attached to the side sill and top of the boiler construction in order to give the requisite strength through the operating cab.



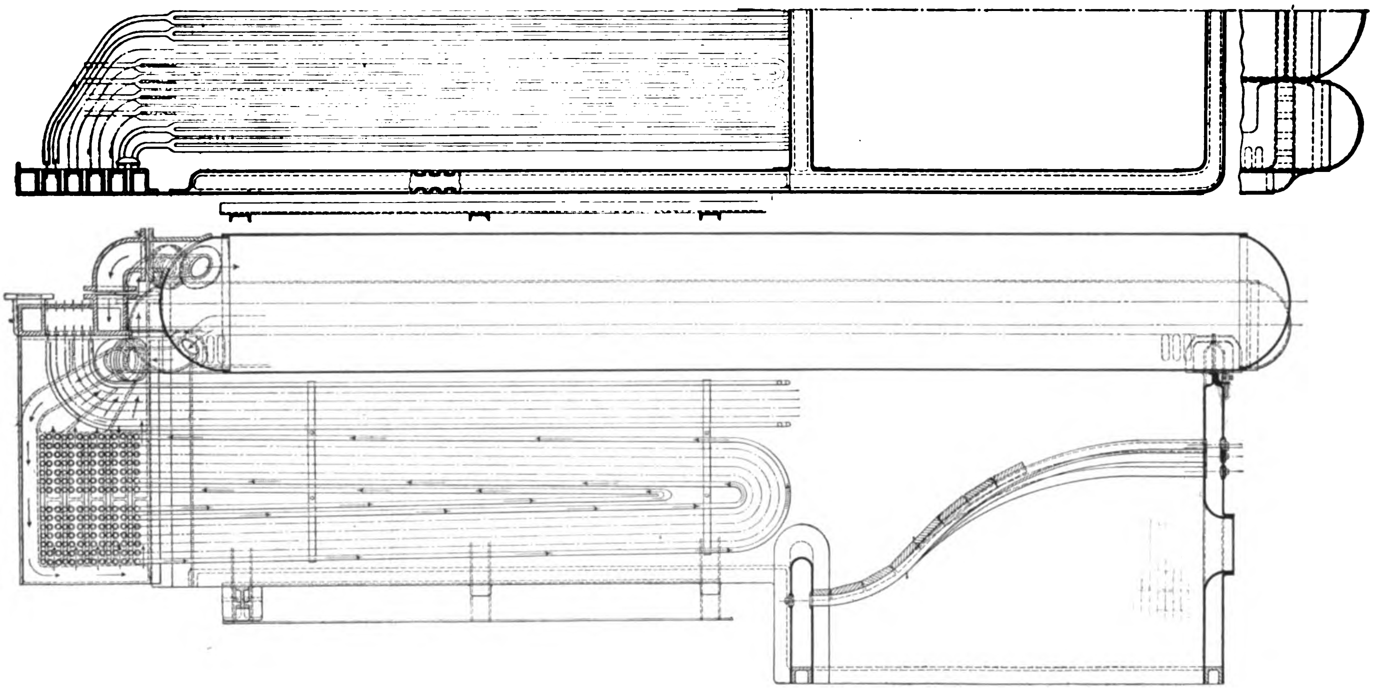
Sections of boiler showing details of construction

Boiler construction and advantages claimed for it

The general arrangement of the form of boiler suggested is shown herewith. While some details have been indicated on this drawing, they are entirely optional as there are a multitude of forms of construction that can be adopted to give the required results. However, it will be seen that the boiler, as shown, consists of two longitudinal drums running for the length of the boiler at the top, which are riveted to a water leg on each side of the boiler which extend down to form the firebox at the rear, and to give a rectangular space in front of the firebox which is carried through to the front end of the boiler. A larger central drum is carried between the two smaller drums, the three drums being fastened rigidly together at the front of the boiler and the central drum slung or suspended towards the rear so as to be free to expand and contract due to differences in temperature. This central drum is connected with nests of evaporating and superheating tubes, which really constitutes the steam generating side of the boiler. The underlying principle in the proposed design, aims at the elimination of all scale forming solids before the water is introduced into the small diameter high pressure evaporating tubes. Practically all scale forming solids are in solution in water at a temperature up to 360 deg. F. Beyond this temperature the solids go out of solution and become mechanically suspended in the water, at which stage they are in such a form that they would be readily deposited or baked into scale through adherence to hot surfaces. It is proposed to retain all solids in the first stage, the feedwater being fed directly into the upper small diameter drums from where it is circulated down into the water legs. This first stage, while carrying 170 lb. pressure, is not intended as an evaporator, but simply as a water heater, the water being carried at a high level in the drums and only sufficient space allowed to take care of the necessary expansion. The water level would be automatically regulated so as to be kept constant, and if a rise in pressure occurred, the water would be automatically passed into the second stage and make up water supplied from the water storage

tank, all the automatic regulation being worked out electrically by means of making and breaking of electric contacts. To transfer water from the low pressure stage into the higher pressure stage, two pumps are proposed mounted directly on the rear heads of the two small diameter outer drums. These pumps would consist of rotors submerged under the constant water level at all times, the rotor shaft having one bearing in the boiler and extending out through a packing gland to the outside of the boiler head where the rotor shaft would be driven by an electric motor. The rotor construction proposed, which would be mounted in a cast housing, also submerged in the interior of the boiler, would first impart a radially outward motion to the water which would tend to create a movement of the water in the casing in which the heavier solids in suspension would be thrown radially outwards, and a small core of water at the center of the moving mass would then be picked up and pressure imparted to it by the pump rotor proper and forced out through a delivery passage and into the central high pressure drum carrying 300 lb. pressure. At the smokebox end of the boiler a combined smokebox and header chamber would be built up by two vertical side headers and one horizontal top header which would be bolted rigidly together and to the side water legs of the first stage, a plate connection also being made between the back wall of the horizontal header and the drum ends. The top horizontal header is the superheater header. The two side vertical headers provide connections for evaporating tubes. The water in the high pressure central drum is led through two delivery pipes to the side headers where it is carried through downward slanting diagonal passages to the front of the headers, and then passed down to horizontal passages at the bottom of the header, from which comb passages rise vertically, exactly as is customary on the standard Type A superheater headers. Nests of evaporating tubes are then connected with ball joints to these lower comb passages, so that the water circulates through the tubes, which have a constant vertical rise and then is carried to comb passages at the top of the vertical side headers which feed into a common top passage, which in turn has a connecting pipe back into the central high pressure drum. All of this construction can be followed by reference to the illustrations and it will be noticed that in order to reduce the number of header connections that the evaporating pipes are made in multiples, two pipes being merged into one before the bend is made to establish the connection to the header, which will be carried out with a ball ring similar to what is now followed in superheater practice.

The evaporating unit clamps are secured to either header by through bolts, the nuts being applied on the outside of the header where they are exposed and readily removed and applied. In order to make the headers gas tight through the bolt holes, the nuts seat on ball washers. The upper or superheater header is connected directly into the steam space of the central drum, the course of the steam and the unit arrangement being exactly similar to the standard Type A superheater construction. In order to reduce connections, the unit pipes are merged together before the bend to the header connection occurs.



General arrangement of the boiler of the proposed steam locomotive

All superheating and evaporating pipes are 1½ in. in diameter. In order to give a definite circulation of water and steam, the feedwater is discharged into the center drum at the rear, is led into the evaporating headers from the front, and is then discharged from the latter in the form of steam towards the rear. The superheater always contains steam, and in the superheated steam passage of the header there are two outlets at which throttle valves are located, which are controlled separately and operated electrically. One throttle governs the supply of steam to the forward driving truck and the other to the rear driving truck.

Construction and method of staying side water legs

Some details of boiler construction have been indicated in the larger drawing among which is the side water leg construction which is shown in the form of vertical corrugations. These are introduced for the purpose of taking up the expansion which would be considerable in water legs of such length. They also serve to stiffen up the construction considerable, which is desirable on account of the boiler partially carrying its own weight. The use of staybolts is necessary in the water legs and

back head, and in this connection, while no definite details are submitted, it is suggested that some new type of flexible staybolt is necessary as none of the bolts heretofore in use is theoretically correct, as the relative movement of the sheets sets up severe strains at the junction of the threaded portion of the bolt and sheet. It is possible that flexible bolts could be made of flexible multi-strand cable which can be developed from very strong wire so that the diameter of the stay will be very much reduced. The flexible cable could be made up with one end permanently secured in a sleeve approximately 1¼ in. long, which would be in the form of a truncated cone with the entrance belled where the cable enters. This cone would rest against a bevelled reamed hole in the sheet, and the head project about 1/16 in. above the sheet to permit a beading being applied by electric welding. After this fixed end is inserted in one side sheet, a similar cone would be slipped over the end of the cable, at the outer side sheet, the cable drawn tight and bonded electrically to the sleeve by passing a current between contacts gripping the sleeve between them. The circumference of the outer sleeve would also be welded to the sheet as was done for the opposite end. Considerable development would be necessary to bring this arrangement to the practical stage, but the use of such stays should materially improve conditions in side sheets. An alternative construction could be used whereby the water legs could be divided into sections and expansion joints provided to take up the forward and rear sheet movement. It will be noted that considerable care has been taken in the proposed construction to allow the location of washout plug directly above the side passages so that free access to the sides for washing out is readily obtained. Manholes would also be located in the three upper drums to permit easy access for cleaning.

The tender

The fuel and water storage space is located at the rear of the operating cab. The fuel storage space consists of a wedge-shape hopper of uniform width, the rear wall of which is sloped at such an angle that the coal is fed forward of its own weight. At the point of the wedge shape hopper, which is at the bottom, the coal is delivered to the stoker conveyor. The fuel space would be shut off entirely from the operating cab, although a door would be provided opening into it for emergency use. The framing construction permits the use of practically any type of stoker desired, and in a simplified form as no universal joints are required as there is no relative movement between the boiler and the fuel storage space, as is the case with the standard type of locomotive and tender. While practically any standard type of stoker can be used, it is suggested that an underfeed stoker of practically identical design as is used in stationary practice would give an efficient arrangement, and possess some advantages over current designs of locomotive stokers. The stoker mechanism would be driven electrically.

Stack draft supplemented by forced draft

As previously mentioned, the exhaust steam from the forward driving unit is ejected directly into the stack in practically the same way as is done at the present time. It is felt that this draft should be sufficient to provide the necessary air for combustion during a considerable portion of the time that a locomotive is in operation. To take care of higher evaporative rates, it is proposed to supplement the stack draft by forced draft to be provided by a compact centrifugal fan located in the operating cab, driven either by a steam turbine or electric motor, depending upon the amount of power required. This fan would feed the air under pressure to hollow grate bars. Most of the air supply would also be heated, the base of the boiler proper being constructed in the form of ducts on the top of which thin fire bricks are cemented in place. The front of these ducts end in a funnel-shape opening at the front of the locomotive which is screened, and, due to the motion of the locomotive, air will be forced through the duct, heated and injected under the grates. The locomotive velocity will, therefore, assist the stack exhaust in injecting the necessary air supply under the grates. The suction for the centrifugal fan would also be connected to these heating ducts to provide as far as possible for the heating of all air used for combustion. It is expected that with such a draft arrangement, a degree of flexibility in boiler operation can be realized that will permit of maximum economy of operation, both as to low and high steam demands. It should also permit of a relatively smaller boiler as forcing should provide for maximum steam requirements.

Combined condenser and feedwater heater in conjunction with the water reservoir

The water storage space at the rear of the locomotive consists of a solid rectangular storage tank, with the exception of a wedge-shape space, through the center, which serves as a fuel storage well, the whole structure being rigidly braced after the manner of standard tender practice. The side walls of the tank will be riveted directly to the structural steel members to give strength to the locomotive body side framing. The side walls would then be panel insulated and covered on the exterior by a series of removable panels which form the exterior of the locomotive. The exhaust from the rear power truck would be used for preheating the feedwater. The heater may be of either the closed or open type, but the closed type is suggested to consist of a horizontal steam cylinder, enclosing water circulating coils after the manner of existing heater construction. The heater would be located in the water tank space at the top, so as to drain the condensate by gravity into the water storage space. The exhaust from the main auxiliary turbo-generator would also discharge into the feedwater heater. The feedwater would be fed direct to the first pressure stage by a compact triplex pump, located below the lowest level so that a gravity feed is obtained. The triplex pump would be gear-driven by an electric motor, so that it can operate at low speed to give a constant low velocity discharge and permit maximum flexibility of regulation.

Auxiliary equipment

In general, it is proposed to operate all auxiliaries by electrical energy developed by a compact direct current generator, direct connected to a steam turbine.

Most of the auxiliary equipment has been already referred to, the boiler feed pumps being electrically driven and the draft pressure fan, either steam or electric driven. It is also proposed to drive the air compressor electrically. The lubrication will be attended to by individual electric motor-driven oil pumps located on the frame of each driving unit. The throttle regulation will also be carried out by electrical control. It will be possible to operate the throttles either separately or in parallel. The cut-off regulation requires only the manual manipulation of a comparatively small lever, as all that is necessary to do is to establish electric connections with proper segments on the commutators surrounding the main axles.

It is proposed that all water levels be automatically regulated by electrical means, so that pumps are automatically cut in as the water levels fall and cut out as they rise to a predetermined level, provisions being made for the engineman manually to control the level if desired. It is further proposed that all water levels be registered

electrically on a central instrument board. To allow the operation of two locomotives together, it is proposed to arrange the controls so that the throttle and valve motion can be entirely regulated from the leading locomotive by cutting in electrical connections between the two locomotives. The water levels and pressures can be also electrically registered on duplicate registering devices on the first locomotive so that one engineman and two firemen may readily operate two locomotives operating in service together.

General comments on electrical control, general construction and possibilities for development

The use of electrical energy for the operation of auxiliaries and the control of the distribution of the steam should open an extensive field for improvement in operation and gains in economy. Automatic electrical control has been developed to a high state on a very wide-spread range of machinery and equipment, and it is felt that its introduction into locomotive engineering should introduce a very marked possibility for greater expansion. It is true that the entire scheme is somewhat visionary, and would require extensive development. On the other hand, the whole proposal would appear to be feasible and the advantages to be gained would merit investigation into its possibilities.

The total overall length of the locomotive between coupler knuckles is 71 ft., which is considerably less than that for modern locomotives of equal capacity. It is felt that the length of the present modern steel passenger cars may be taken as a possible limit of length, which is 85 ft. There is, therefore, 14 ft. expansion still possible for greater capacity locomotives. The locomotive shown can have its wheel arrangement modified to provide for two-wheel engine trucks, which would permit the use of three pairs of 58-in. diameter driving wheels in practically the same length of wheel base, so with very little increase in length it would be possible to develop a tractive force of 110,000 lb. without exceeding a 60,000-lb. axle load. With further increases in the weight on drivers within limits that are now being worked to, still further large increases in tractive force are possible, if necessary for special designs of heavy service locomotives. All tractive forces quoted have been for conservative factors of adhesion, and it is expected that with a practically constant torque, especially with the increase in number of drivers, that lower adhesion can be worked to, which again will permit further increases in tractive force. When it is considered that a tractive force of 180,000 lb. can be developed with eight 58-in. diameter drivers, 300-lb. steam pressure and cylinders 20-in. diameter, it will be seen that there are ample possibilities for development of the proposed type of locomotive without going to excessive weights or size of cylinders. It is, however, thought that further development can be made with higher pressures as this is one of the most fruitful sources for gains in economy of operation. Three hundred pounds pressure has been selected as a moderate advance which would permit appreciable superheat without exceeding a total steam temperature of 700 to 750 deg. F. With the construction proposed, however, there is no reason why higher pressures cannot be used as soon as sufficient experience has been gained, which will have the effect of holding down cylinder sizes with minimum effect on weights of reciprocating parts. The cost of a locomotive, as herein described, would be greater on a weight basis than the standard type steam locomotive. The cost should, however, be very much less than equal capacity electric locomotives and the gain in economy and increased flexibility of operation should warrant any increase in cost which, viewed from any angle, should be very much less than any type of Diesel or turbine locomotive yet proposed.

One feature that may be criticized in the proposed assembly is poor vision for the engineman on account of the location of the operating cab. It is possible that a rearrangement of the boiler, fuel and water spaces might better this, but it is felt that the vision provided is equal to what exists on the largest locomotives now in service, on which feedwater heaters and other appliances restrict the view fully as much as in the proposed form. In order to give the engineman some protection in severe weather, a permanent lookout can be built on the side of the cab, projecting out approximately 6 in., similar to what is done on some classes of cars at the present time, which used in conjunction with some form of clear vision window, should give equal or better vision than what is obtained on large locomotives now in service.

In conclusion, it should be stated that although there is very little new in what has been suggested, yet the proposed regrouping of old ideas constitutes some novel and radical combinations. All these require very thorough investigation before adoption is possible, which, on account of the magnitude of the task, it is almost impossible to make without the undivided efforts of a considerable and experienced engineering staff. For this reason it is thought more desirable to submit the above grouping of ideas for discussion and comment in the hope that locomotive engineering as a whole will benefit, rather than to attempt to prove or disprove the proposals by private development.

Table of dimensions, weights and proportions

Type of locomotive, Thermo-electric	4-4-0+4-4-4
Service	Freight
Cylinders, diameter and stroke	8—13 in. by 26 in
Valve gear, type	Any
Valves	Piston or poppet
Cut-off in full gear, per cent	Zero to 100
Weights in working order:	
On drivers	240,000 lb.
On each of 3 trucks	100,000 lb.
Total engine and tender	540,000 lb.
Wheel bases:	
Rigid	5 ft. 6 in.
Total engine	62 ft. 9 in.
Total engine and tender	62 ft. 9 in.
Wheels, diameter outside tires:	
Driving	63 in.
All trucks	36 in.
Journals, diameter and length:	
Standard	A. R. A.
Boiler:	
Steam pressure	300 lb.
Fuel, kind	Bituminous
Arch tubes, number	7
Heating surfaces.	
Firebox and shell	612 sq. ft.
Water tubes	2,870 sq. ft.
Total evaporative	3,482 sq. ft.
Superheating	1,328 sq. ft.
Comb. evaporative and superheating	4,810 sq. ft.
Special equipment:	
Brick arch	Yes
Superheater	Type A
Feedwater heater	Built in
Stoker	Underfeed
Tender:	
Water capacity	9,000 imp. gal., 10,800 U.S. gal.
Fuel capacity	12 ton
General data estimated:	
Rated tractive force	71,400 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	44.5
Weight on drivers ÷ tractive force	3.36
Total weight engine ÷ comb. seat. surface	112.2
Boiler proportions:	
Tractive force ÷ comb. heat. surface	14.8
Tractive force × dia. drivers ÷ comb. heat. surface	935.6
Firebox heat. surface, per cent of evap. heat. surface	17.6
Superheat. surface, per cent of evap. heat. surface	38.1

THE WISCONSIN LAW requiring curtains on locomotive cabs has been sustained by the Supreme Court of that state. This ends litigation in the state courts which was begun in 1923, when the law was passed. The court held that the law was passed in the interest of the public health and therefore does not violate the principle of federal regulation of interstate commerce. The railways are expected to appeal the case to the United States Supreme Court.

Locomotive and motor car orders in 1925

Three new locomotive types developed during the past year —Increasing interest in the Diesel engine

THE number of locomotives ordered for domestic service in the United States during 1925 totaled only 1,055. This figure compared with 1,413 in 1924; with 1,944 in 1923 and with 2,600 in 1922, shows that last year was the third successive year in which there has been a substantial decrease in locomotive orders from the year preceding. The 1925 total was, furthermore, the smallest for any year since 1900, with the exception of the subnormal years of 1919 and 1921. Of the 1,055 locomotives ordered last year, 14 were oil or Diesel-electric and 28 were electric locomotives. Orders placed by the railroads in Canada with the locomotive builders only amount to 10, as compared with 71 ordered in 1924 and 82 ordered in 1923, as shown in Table 1.

An interesting feature in the locomotive orders for 1925 is the number ordered for export to Central and South America. Of the 209 locomotives exported, 46 went to Brazil and 62 went to other countries in South and Central America. This is due principally to the fact that many of the railroads of South and Central America have been required to borrow money for new equipment and improvements in the United States. In 1924, the National Railways of Mexico ordered 50 locomotives as well as a large number of cars. There were, however, no locomotives sold to Mexico in 1925. Other export business, aside from the countries mentioned, totaled 101 locomotives. The number of locomotives built for domestic service—in contradistinction to new business taken as shown in the total number of orders—was 994. This figure was inclusive of Canadian production. It compared with 1,810 in 1924, and with 3,505 in 1923, and was the smallest total reported since 1897.

Table I—Orders for locomotives since 1918

Year	Domestic	Canadian	Export	Total
1918	2,593	209	2,086	4,888
1919	214	58	989	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626
1925	1,055	10	209	1,274

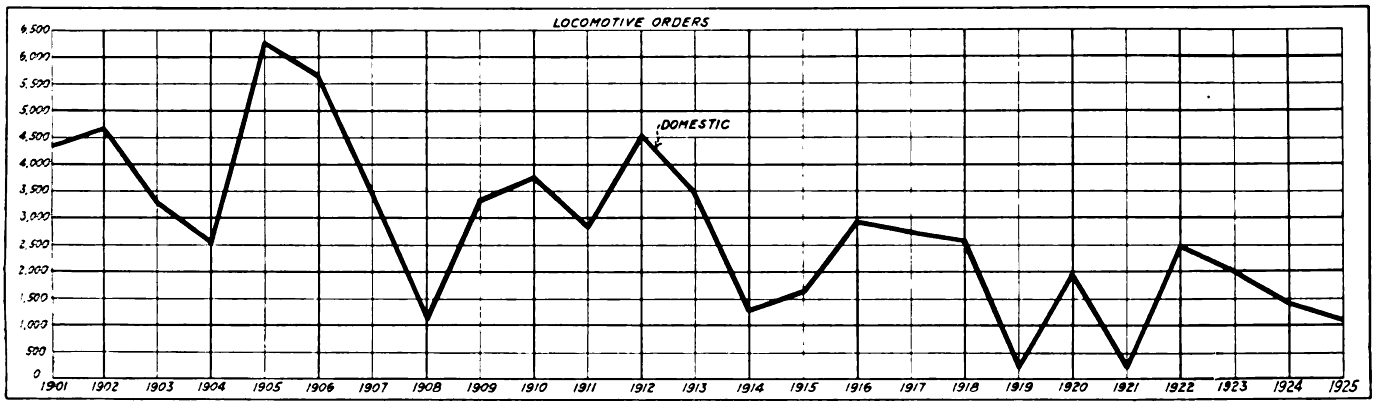


Chart showing the locomotive orders, 1901 to 1925

The Car Service Division of the American Railway Association reports monthly totals of locomotive installations and retirements. For the year 1924 these reports showed that there were installed 2,246 locomotives and that there were retired 2,148. The last report available for 1925 to date is that for November. In the first 11 months of 1925, installations totaled 1,604—indicating a figure for the year approximating the total for 1924—while retirements for the 11 months totaled 2,626.

Types of locomotives ordered

Table II gives a summary of the more important orders placed in 1925 grouped according to roads and types.

Table II—Important locomotive orders in 1925

	0-6-0	0-8-0	2-8-2	2-8-4	2-10-0	2-10-2	2-10-4	Mallet	4-6-2	4-8-2
A. T. & S. F.	..	..	..	..	..	15	..	..	..	..
A. C. L.	8	10	..	..	..	20	..	..	75	..
B. & O.	..	..	..	..	..	50	..	..	..	..
Belt Ry. of Chicago	..	5	..	..	..	..	..	..	..	..
B. & A.	..	..	..	25	..	..	..	..	..	..
Can. Nat.	..	..	..	..	..	..	..	..	..	5
C. of Ga.	..	..	..	..	..	10	..	..	..	10
C. & O.	..	..	50	..	..	..	..	20	5	..
C. B. & Q.	..	..	..	..	..	..	..	..	..	13
C. R. I. & P.	..	10	..	..	..	10	..	..	..	..
D. & R. G. W.	..	..	10	..	..	..	..	..	..	10
Detroit Terminal	..	7	..	..	..	..	..	..	..	..
Fla. E. C.	..	6	15	..	..	..	..	..	..	12
Great Northern	..	..	16	..	..	..	..	..	..	..
Gulf C. L.	..	..	10	..	..	..	..	..	..	..
G. M. & N.	..	..	..	..	5	..	..	..	..	..
Hocking Valley	..	10	..	..	..	..	..	..	..	..
I. G. N.	..	..	..	..	..	..	..	..	5	..
K. C., M. & O.	..	..	..	..	5	..	..	..	..	..
L. & N.	..	..	24	..	..	..	..	..	..	8
M. P.	..	15	..	..	..	10	..	..	..	..
N. C. & St. L.	..	..	..	..	..	..	..	..	..	5
N. Y. C.	..	5	..	..	..	..	..	..	..	100
N. Y., C. & St. L.	..	20	..	..	..	..	..	..	..	..
N. Y., N. H. & H.	..	..	..	..	..	..	..	..	..	10
N. & W.	..	..	..	..	..	..	..	..	..	10
Reading	..	5	..	..	..	..	..	..	..	..
St. L.-San Fran.	..	..	30	..	..	..	..	..	..	15
S. A. L.	..	..	74	..	..	..	..	..	..	21
T. & P.	..	10	..	..	..	..	10	..	..	5
Wabash	..	25	..	..	..	..	..	..	..	..

This list includes 854 locomotives for 31 railroads, or 80.2 of the locomotives ordered by the American and

Canadian roads. The balance was in small orders from a number of railroads.

A list of the types of locomotives which were ordered for the railroads, industrial concerns and for export is shown in Table III. Similar information for the preceding year is given on page 91 of the February, 1925, issue of the *Railway Mechanical Engineer*. For the railroads alone, a total of 993 locomotives were ordered in 1925. Of this total, 453 or 25.5 per cent were for freight service and 338 or 34 per cent were ordered for passenger service.

Table III—Types of locomotives ordered in 1925

Type	Railroad	Industrial	Export	Total
0-4-0	0	13	0	13
0-6-0	22	14	0	36
0-8-0	132	0	0	132
0-10-0	1	0	0	1
2-6-0	1	2	3	6
2-6-2	4	7	2	13
2-6-4	0	1	0	1
2-8-0	17	3	37	57
2-8-2	247	15	84	346
2-8-4	25	0	0	25
2-10-0	11	0	0	11
2-10-2	115	0	0	115
2-10-4	10	0	0	10
Mallet	22	3	0	25
4-4-0	0	1	6	7
4-4-2	5	0	0	5
4-6-0	1	0	4	5
4-6-2	93	0	41	134
4-8-0	4	0	0	4
4-8-2	235	0	16	251
4-12-2	1	0	0	1
Geared	0	11	0	11
Miscellaneous	47	2	16	65
	993	72	209	1,274

For switching service 155 locomotives were ordered. The preponderance of the orders were for the 0-8-0 type, which was the same as for 1924, 295 being ordered in that year and 132 in 1925. The largest orders for switch engines were those placed by the Missouri Pacific and the New York, Chicago & St. Louis, for which there were 15 and 20 of the 0-8-0 type, respectively. There were only eight of the 0-6-0 type ordered in 1925, as compared to 13 ordered in 1924. All of the 0-6-0 type ordered last year were for the Atlantic Coast Line.

Of the locomotives with two-wheel leading trucks and three, four or five pairs of drivers, locomotives of the 2-8-2 type were the largest number ordered last year. In this group are 247 or 25 per cent of the total. The next largest number ordered is the 2-10-2 type of which there is a total of 115, or 11.6 per cent of the total. Roads which placed orders for at least 25 locomotives of the 2-8-2 type were the Chesapeake & Ohio, the St. Louis-San Francisco and the Seaboard Air Line. The Baltimore & Ohio ordered 50 of the 2-10-2 type which was the largest order for that type placed during the year.

Table IV—Principal orders for 4-8-2 locomotives in 1925

Road	No.	Weight, lb.	Tractive force, lb.
New York, New Haven & Hartford	3	376,000	67,300
New York Central	100	368,700	72,700
Chicago, Burlington & Quincy	13	367,700	52,750
New York, New Haven & aHrtford	7	360,000	67,300
St. Louis-San Francisco	10	346,000	54,100
Louisville & Nashville	8	327,000	53,900
Seaboard Air Line	10	320,900	48,200
	11	320,500	48,200
Florida East Coast	12	318,000	44,000
Central of Georgia	10	316,500	47,800

There were 22 Mallet locomotives ordered in 1925, or 12 less than the number ordered in 1924. The largest order for this type was 20 for the Chesapeake & Ohio. Of the total of 338 locomotives ordered last year of the type usually employed in passenger service, 235 were of the 4-8-2 type or 23.7 per cent of the total. The second largest group is 93 of the 4-6-2 type, of which 75 were ordered by the Atlantic Coast Line.

During the past year, three new types of steam locomotives appeared on the railroads of the United States. These are the 2-8-4 type, built by the Lima Locomotive Works, Inc., the 4-10-2, three-cylinder locomotives, built for the Southern Pacific and Union Pacific by the American Locomotive Company, and the 2-10-4 type recently received by the Texas & Pacific from the Lima Locomotive Works, Inc. The Southern Pacific 4-10-2 type locomotives, of which 16 were ordered in 1924, have a tractive force of 76,900 lb. without the booster, 83,500 lb. with the booster, and a weight of 306,000 lb. on the drivers. The 2-8-4 type which was described in the May issue of the *Railway Mechanical Engineer,* has a tractive force of 69,400 lb. without the booster and 82,600 lb. with the booster. The total weight on the drivers is 248,200 lb. The 2-10-4 type built for the Texas & Pacific, was described in the January issue of the *Railway Mechanical Engineer,* page 5. It has a rated tractive force of 83,000 lb. with the engine and 96,000 lb., including the booster. The weight on the drivers is 300,000 lb.

Table V—Principal orders for 2-8-2 locomotives in 1925

Road	No.	Weight, lb.	Tractive force, lb.
Chesapeake & Ohio	50	357,500	67,700
St. Louis-San Francisco	15	344,600	59,800
	15	328,800	59,800
Gulf Coast Lines	10	333,000	59,800
Great Northern	7	320,100	56,600
	9	283,420	50,600
Louisville & Nashville	24	320,000	60,000
Seaboard Air Line	54	302,000	66,200
Florida East Coast	15	297,000	54,700
Denver & Rio Grande Western	10	171,420	36,200

New locomotive types are the result of efforts to meet demands for increased capacities

The new locomotive types exemplify the continuous effort for an increase of locomotive capacity which has been characteristic of steam locomotive development throughout its history. The Lima 2-8-4 type locomotive represents an effort to meet the demand for increased train load and the reduction of time on the road. The purpose of an additional pair of truck wheels incorporated in the 4-10-2 design of the ten-coupled 3-cylinder locomotives is to meet the demand for the utmost in horsepower capacity which can be secured from a locomotive with a given number of driving wheels by providing the largest practicable boiler. The same may be said for the Texas & Pacific 2-10-4 type locomotives which are a development from the 2-8-4 type design.

Articulated type locomotives still retain their usefulness under special operating conditions. There is a marked tendency in recent locomotives of this type toward the use of simple cylinders. An outstanding locomotive of this type built during the past year is the Great Northern 2-8-8-2 type locomotive which has four 28-in. by 32-in. cylinders and has a starting tractive force at a maximum cut-off of 65 per cent of 127,500 lb.

Table VI—Principal orders for 0-8-0 locomotives in 1925

Road	No.	Weight, lb.	Tractive force, lb.
Reading	5	280,610	67,900
Terminal R. R. Assn. of St. Louis	2	252,500	60,300
Detroit Terminal	5	239,000	55,200
Chicago, Rock Island & Pacific	10	230,000	......
Missouri Pacific	15	224,490	53,958
New York, Chicago & St. Louis	20	221,000	51,000
Texas & Pacific	10	220,000	54,500
Hocking Valley	10	221,000	51,200
Wabash	25	217,500	52,921
Florida East Coast	6	216,000	51,000
Atlantic Coast Line	10	215,300	51,041

Tendencies as to size

The idea of the size of locomotives required to meet present day operating conditions may be obtained by

referring to Tables IV to VI, inclusive, in which important orders for the leading types placed last year are grouped according to weight. Similar information for the 0-8-0, 2-8-2, 4-6-2 and 4-8-2 types of locomotives ordered in 1924 will be found on pages 91 and 92 of the February, 1925, issue of the *Railway Mechanical Engineer*.

The majority of the locomotives of the three-cylinder design ordered in 1925 were of the 4-8-2 type. The Louisville & Nashville placed the largest order for locomotives of this design included in Table IV. The weight of these locomotives does not differ materially from the average weight of those of two-cylinder design.

As shown in Table V, the heaviest locomotives of the 2-8-2 type were ordered by the Chesapeake & Ohio. These locomotives have a weight of 357,500 lb., which is 12,900 lb. heavier than those of the St. Louis-San Francisco, listed in the same table. The five 0-8-0 type locomotives ordered by the Reading, weigh 280,610 lb., which is approximately 34,000 lb. heavier than the three-cylinder 0-8-0 locomotives ordered by the New York, New Haven & Hartford in 1924. The largest order for locomotives of the 0-8-0 type, shown in Table VI, is for 25 ordered by the Wabash.

Comments on design

Three developments of outstanding interest in design which have appeared during the past year were all incorporated in the two new locomotive types built by the Lima Locomotive Works, Inc. These are the articulated four-wheel trailing truck, the added capacity of which has been utilized to increase the size of the firebox and boiler; the cast steel cylinder with its saving in weight, which again permits more weight in the boiler, and the articulated main rod which, by delivering the driving force to two, instead of to one main crank pin, has materially increased the limit of cylinder load which can be taken up by a single coupled driving wheel base from a single pair of cylinders without excessive crank pin and driving box loads.

A year ago in discussing the tendencies of equipment design of 1924, attention was called to the Delaware & Hudson consolidation type locomotive designed by John Muhlfeld, the most important factor of which was probably its boiler pressure of 350 lb. During the past year, no locomotives have been built in America to carry such high boiler pressures, but there has been some increase in the use of pressures considerably above 200 lb., which for many years has been quite general practice.

The outstanding development in the use of high pressures this year took place in Europe. A German locomotive has been been built with a boiler generating steam at two pressures. Superheated high pressure steam at 850 lb. per sq. in. is used in a single high pressure cylinder and the exhaust from this cylinder, at about 200 lb. per sq. in., is combined with superheated steam at the same pressure drawn from the low pressure section of the boiler, to supply the two low pressure cylinders. Little is known as to the performance of this locomotive, but a marked economy in steam consumption is reported.

The tendency towards large tender capacity is continued during 1925. Many of the locomotives built during the year have been equipped with tenders carrying from 12,000 to 15,000 gallons of water and as much as 20 tons of coal and 5,000 gallons of oil.

The Diesel locomotive

A total of 14 Diesel-electric locomotives were ordered for domestic service in 1925. A list of these locomotives is shown in Table VII. Nine of the units ordered last year have Ingersoll-Rand oil engines. One is a gas-

Table VII—Oil-electric or Diesel-electric locomotives ordered in 1925

Purchaser	No.	Wheel arrangement	Service	Weight, lb.	Tractive force, lb.	Cylinders, No., dia. and stroke	Builders
Baltimore & Ohio	1	0-4-4-0	Sw.	120,000	50,000	6—10x12	Ingersoll Rand-Amer.-Gen. Elec.
Central of New Jersey	1	0-4-4-0	Sw.	120,000	30,000	6—10x12	Ingersoll Rand-Amer.-Gen. Elec.
Chicago & North Western	1	......	Sw.	120,000	......	....	Ingersoll Rand-Amer.-Gen. Elec.
Delaware, Lackawanna & Western	2	......	Sw.	120,000	......	....	Ingersoll Rand-Amer.-Gen. Elec.
Erie	1	0-4-4-0	Sw.	120,000	300 hp.	6—10x12	Ingersoll Rand-Amer.-Gen. Elec.
Lehigh Valley	1	0-4-4-0	Sw.	120,000	36,000	6—10x12	Ingersoll Rand-Amer.-Gen. Elec.
Long Island	1	......	Frt. and sw.	200,000	600 hp.	6—10x12	Ingersoll Rand-Amer.-Gen. Elec.
	1	Gas-electric	....	120,000	500 hp.	....	Westinghouse-Brill.
New York Central	1	4-8-4	Pass.	296,000	......	....	McIntosh & Seymour-Amer.-Gen.-Elec.
	1	4-8-4	Frt.	257,000	......	....	Ingersoll Rand-Amer.-Gen. Elec.
Pennsylvania	3	0-4-0	Sw.	130,000	42,500	....	Bessemer-P. R. R. Shops.

Table VIII—Rail-motor car orders in 1925

	Gasoline	Gas-electric	Steam	Trailers	Total
United States	75	54	0	19	148*
Canada	7	0	0	0	7
Export	32	1	1	0	34
Total	114	55	1	19	190*

*Includes 19 trailer cars.

Table IX—Number, type and weight of rail motor cars ordered in 1925, for service in the United States and Canada

Builder	Type of power plant	No. motor cars	Horse-power	Nominal weight, lb.
J. G. Brill Co.	gasoline	1	250	55,000
	gasoline	1	50	21,000
	gasoline	2	65	50,000
	gasoline	5	70	30,000
	gasoline	1	125	30,000
	gasoline	7	150	53,000
	gasoline	2	175	53,000
	gasoline	9	190	53,000
	gasoline	6	190	54,000
	gasoline	2	190	56,000
	gasoline	6	190	57,000
	gasoline	1	190	58,000
	gasoline	1	190	59,960
	gasoline	1	190	65,200
	gasoline	1	...	70,000
	gas-electric	1	175	74,400
	gas-electric	2	250	76,000
	gas-electric	3	250	80,000
	gas-electric	6	250	90,000
	gas-electric	7	250	110,000
Westinghouse-Brill	M. U. gas-electric	1	250	88,000
Canadian Pacific*	gasoline	2	150	33,300
Edwards	gasoline	1	40	12,000
	gasoline	1	75	18,000
	gasoline	4	200	42,000
	gasoline	3	200	43,000
	gasoline	6	200	69,000
	gasoline	1	104	50,000
Electro-Motive Co.	gas-electric	6	175	70,000
	gas-electric	2	175	72,000
	gas-electric	6	175	78,600
	gas-electric	1	175	79,900
	gas-electric	3	185	72,000
	gas-electric	5	200	73,000
	gas-electric	2	400	......
	gas-electric	2	200	76,000
	gas-electric	4	210	83,000
	gas-electric	2	105	70,000
Liveoak, Perry & Gulf*	gasoline	1	70	17,000
Mack Motor Car Co.	gasoline	1	80	20,000
Meister Co.	gasoline	1	60	12,000
Pullman	gas-electric	2	300	......
Railway Motors Corp.	gasoline	2	208	79,300
	gasoline	2	208	70,000
	gasoline	3	208	75,000
H. J. Reith	gasoline	1	125	30,000
Sykes	gas-electric	2	175	62,000
	gasoline	5	225	59,180
		137		

*Built in company shops.

electric locomotive built jointly by the Westinghouse and J. G. Brill Companies; one built jointly by McIntosh & Seymour, American Locomotive Company, General Electric Company, and three by the Bessemer Gas Engine Company and the Pennsylvania Railroad. The heaviest locomotive of this class is the 600-hp. oil-electric locomotive for freight and switching service recently delivered to the Long Island Railroad, which weighs 200,000 lb.

Rail motor cars ordered in 1925

In 1923, the railways in the United States and Canada ordered 76 rail-motor cars; in 1924, the number increased to 120, and for 1925 the lists show a total of 137. Of this total, 82 are driven direct by gasoline engines of which seven were ordered by Canadian railways, 54 are gas-electric transmission and one has multiple-unit control. Table VIII shows the number of rail motor cars ordered for service in the United States and Canada and for export. Shown in Table IX is a list of the rail-motor cars ordered in 1925 for service in the United States and Canada, classified according to the builder, type of power plant, horsepower and nominal weight. Among the important orders for rail-motor equipment is that placed by the Boston & Maine, which includes a total of 12 rail-motor cars and five trailers. The Missouri Pacific also placed orders for seven motor cars and five trailers.

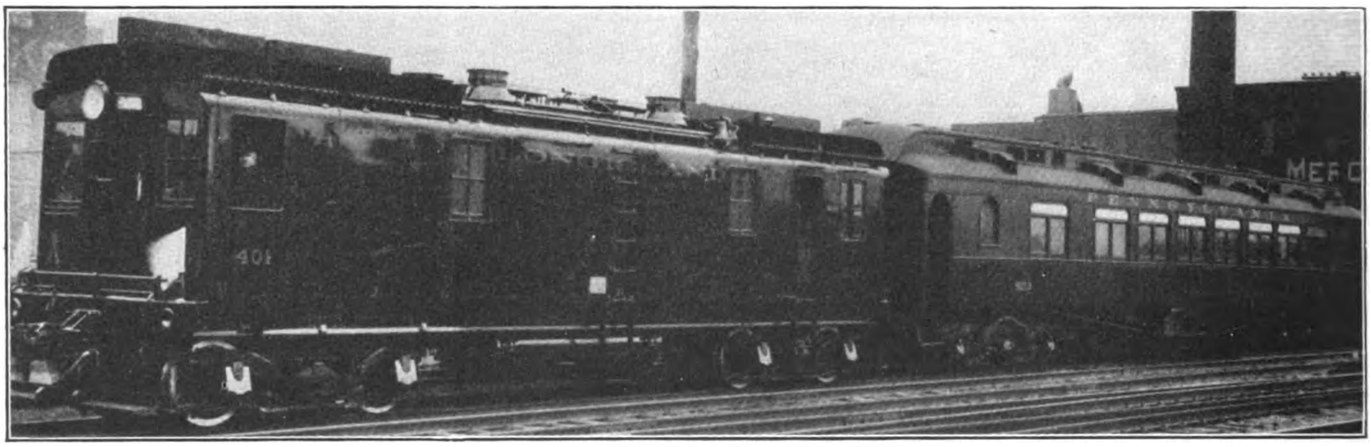
Undoubtedly the outstanding development in rail-motor cars built during the past year is the application of the Diesel engine to a number of cars on the Canadian National and the application in two of these of the articulated principle with a 350-hp. motor. These cars were described in the November, 1925, issue of the *Railway Mechanical Engineer*. The design of these motors in themselves is of more than ordinary interest because of the high crank shaft speed and the unusually light weight per horsepower which was attained in them.

Another development in design which has been embodied in many of the orders placed during 1925, is the double-end control, where electric transmission is used. This has been worked out to a point where multiple unit control is available should there be any demand for trains using more than one motor car. There has been a general tendency to increase the weight and horsepower capacity of this equipment.

100-ton oil-electric locomotive

Built for freight and switching service on the Long Island — Develops a tractive force of 60,000 lb. at one mile an hour

A 100-ton oil-electric locomotive built jointly by the Ingersoll-Rand Company, the General Electric Company, and the American Locomotive Company was delivered the latter part of December, 1925, to the Long Island for use in freight and switching service. This locomotive was run under its own power, hauling five loaded box cars, one passenger car and a caboose, from Erie, Pa., to Greenville, N. J. Records taken during this run show a consumption of 473 gal. of fuel oil for a total running time of 28 hr. 45 min.

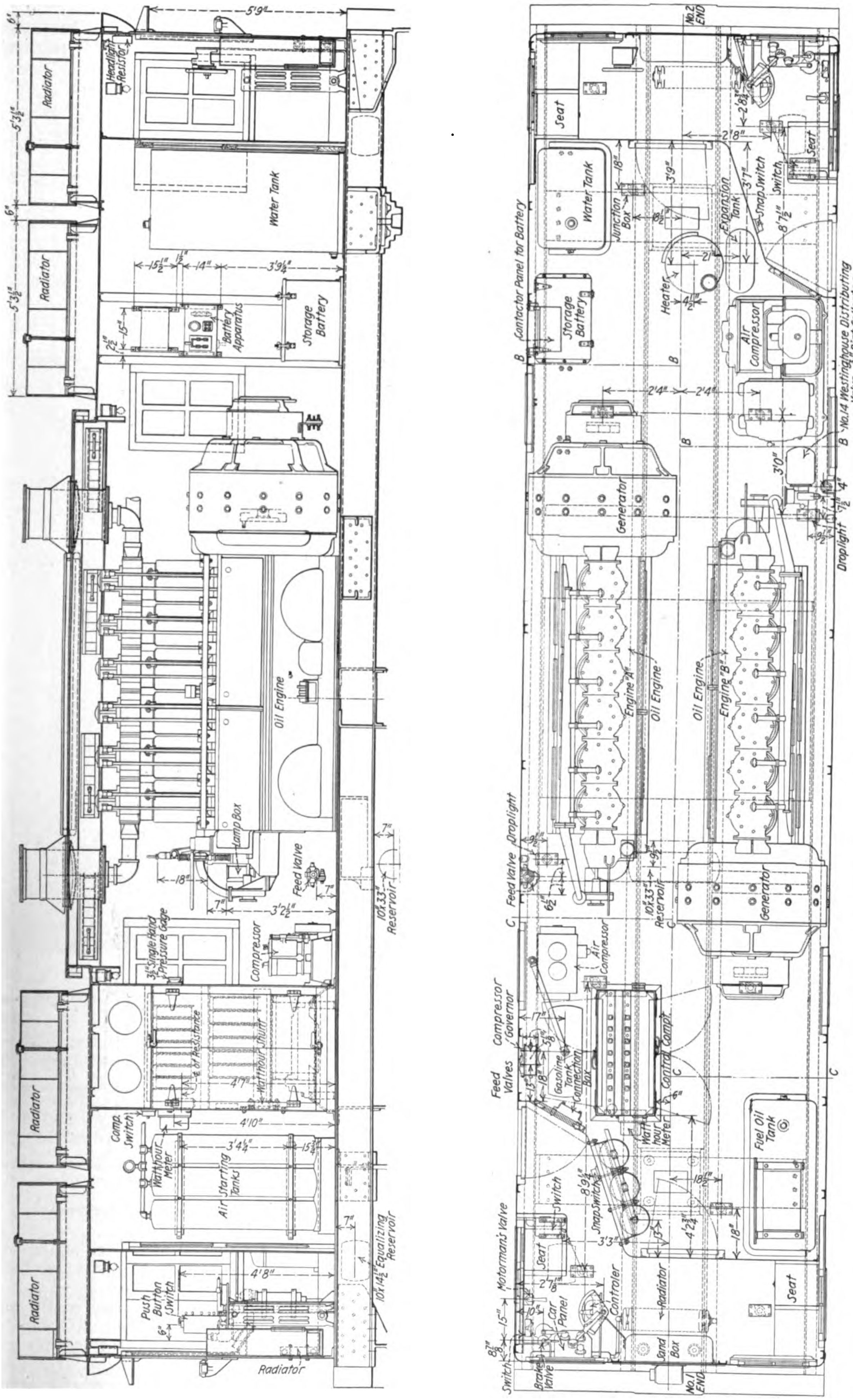


100-ton oil-electric locomotive built jointly by the General Electric Company, Ingersoll-Rand Company and the American Locomotive Company

The design and construction of the 100-ton locomotive is similar in many respects to the 60-ton oil-electric locomotive built by the same companies and described in the July, 1924, issue of the *Railway Mechanical Engineer*. One of these 60-ton locomotives has been in switching service for several weeks in the Bronx, N. Y., freight terminal yards of the Central Railroad of New Jersey.

The cab of the 100-ton oil-electric locomotive is of all-steel construction and extends the entire length of the locomotive. Its general appearance is similar in many respects to that of an electric locomotive. The width of the cab is 9 ft. 4 in. and the overall length is 40 ft. The overall height of the locomotive, measured from the top of the rail, is 13 ft. 9½ in. The cab is divided into three compartments. The central compartment contains the power plant, oil and water tanks, control equipment and heater. The two end compartments are reserved for the control and operating apparatus. Clear vision for the operator is provided by means of end and side windows. A hatch is provided in the roof of the central compartment directly above the oil engines to permit their removal. A smaller hatch is also provided in the main hatch to facilitate inspection.

The major equipment consists of two 300-hp., six-



Elevation and floor plan drawings of the 100-ton oil-electric locomotive for the Long Island

cylinder, four-cycle, Ingersoll-Rand oil engines, operating at 600 r.p.m., which are located along each side of the central compartment and midway between the two trucks; and two General Electric, type TDC-6, 200-kw., 600-volt generators, directly connected to the oil engines. The generators are placed at opposite ends of the central compartment in order to secure an even distribution of the load. They supply current to four General Electric, 600-volt railway motors which are geared directly to the axles.

The oil engines

The oil engines are of the vertical, six-cylinder, four-cycle, single acting, variable speed type having direct fuel oil injection, which is effected by means of two opposed spray nozzles in each combustion chamber. Oil is delivered to the nozzles under pressure by an injection pump driven from the main shaft. Ignition is accomplished by the heat of compression only. One fuel injection pump for each engine serves all six cylinders. Fuel oil distribution is effected by a distributor timed to admit oil successively to the spray nozzles of each cylinder in the proper firing order. The engines are rated for a fuel consumption not to exceed .43 lb. per b.hp. at the rated load and speed based on oil containing 19,000 b.t.u. per lb. and having a flash point not lower than 150 deg. F. The total capacity of the fuel oil tanks is 400 gal.

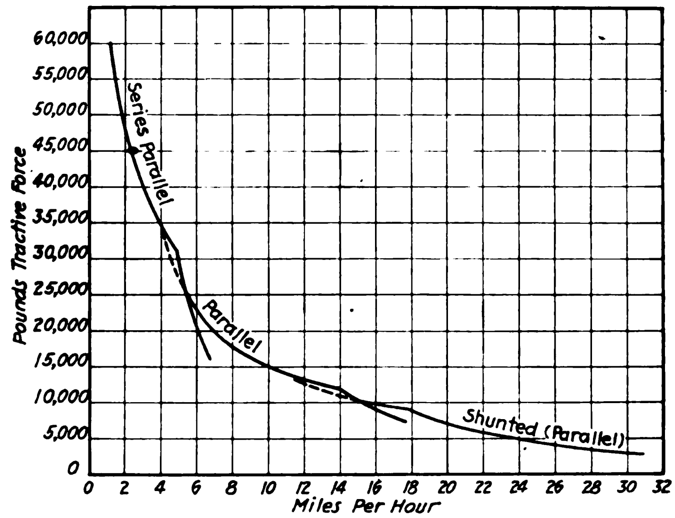
Each engine is equipped with a self-contained, force feed lubricating system. Lubricating oil is pumped to the various moving parts of the engine by a gear-driven pump located in the crank case. Provision is made to filter the oil which comes in contact with the cylinder walls before it is returned to the oil reservoir.

The cylinders, cylinder heads and combustion chambers are completely water-jacketed. Cooling water is circulated by a centrifugal pump driven from the crank shaft. The temperature of the water in the engine jackets is regulated by a thermostatic valve which controls the circulation of the cooling water from the engines to the radiators on the roof of the cab.

The engines are started by compressed air at approximately 200 lb. pressure, which is admitted to each cylinder in succession through mechanically operated starting valves. Compressed air for starting is provided by a Mianus two-cycle gasoline driven air compressor. Three high pressure air storage tanks are also provided for retaining a supply of compressed air for starting the oil engines.

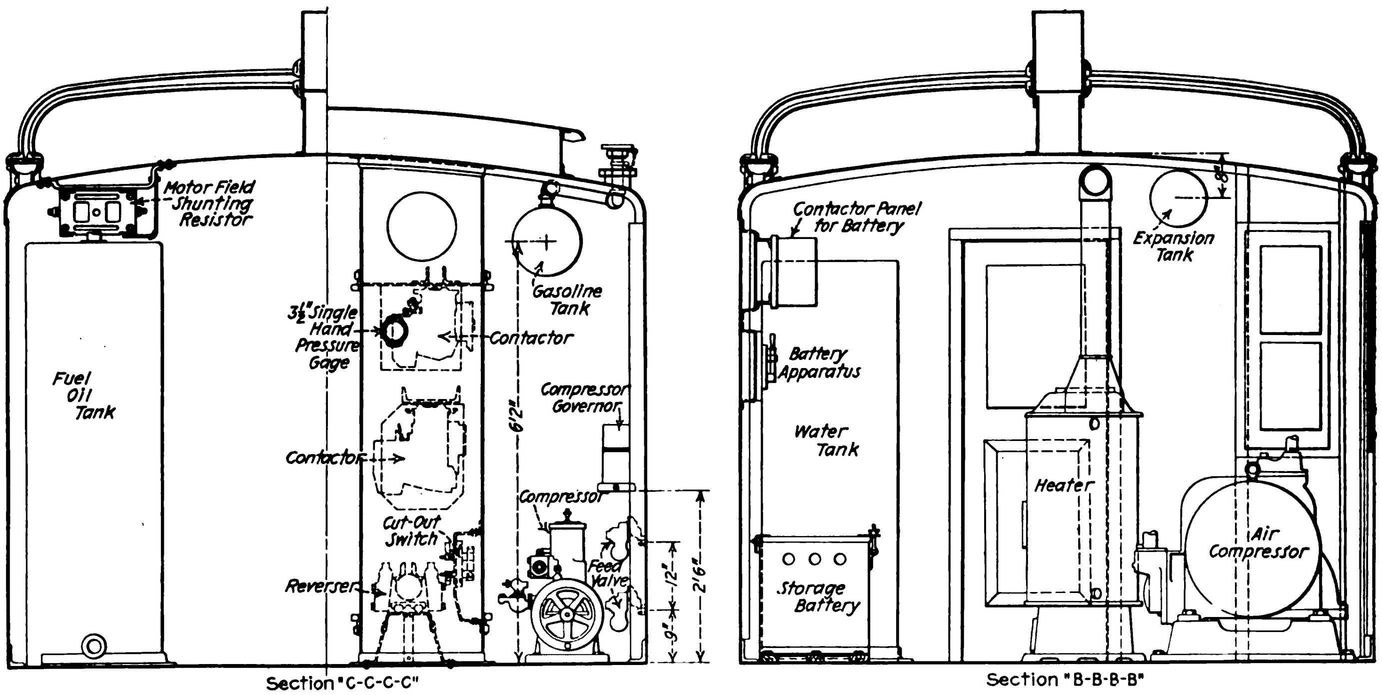
The electrical equipment

The generators are 200-kw., 600-volt, direct current, compound-wound, and are separately excited. The voltage is regulated by the current demands of the traction motors so that the product of this current and the voltage is constant for any given engine speed. This makes it possible for the full power capacity of the oil engines to be applied to the drawbar at any speed of the locomotive, and accounts for the relatively large tractive force rating of this type of locomotive.



Speed-tractive force curve of 100-ton oil-electric locomotive

A 6-kw., 60-volt exciter is mounted on the same shaft with the main generator. A 32-volt, 100-amp.-hr. Exide Ironclad storage battery is charged by this exciter in series with one of the field windings. The exciter and storage battery circuit, which is used for lighting and



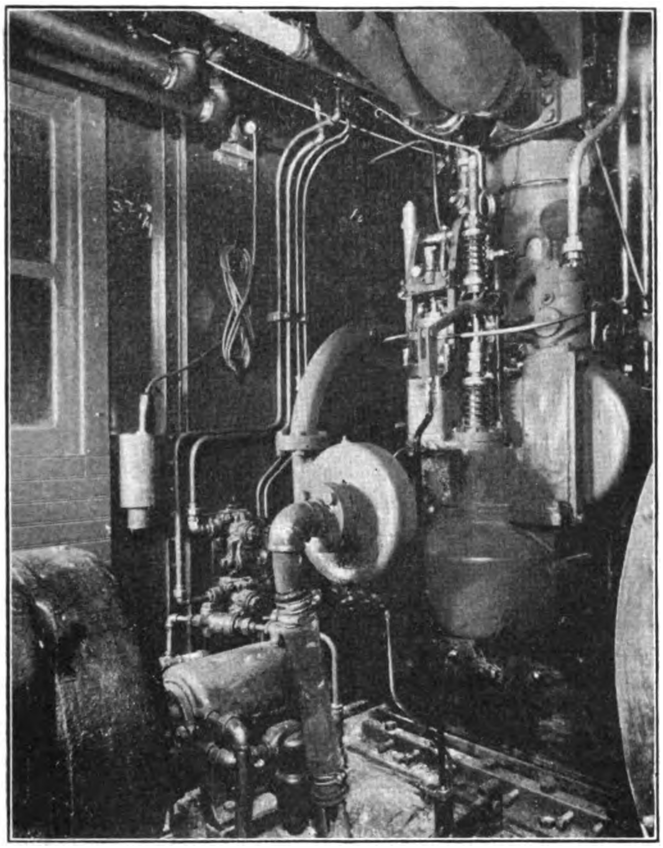
Cross section drawings through the engine compartment of the Long Island oil electric locomotive

control, is controlled automatically by a switch on the main throttle of the locomotive.

Mounted on each of the four driving axles is a direct current, series motor of the single-geared, box frame, railway type, GE-69-C, manufactured by the General Electric Company. Each motor is supported on its axle by axle brackets and bearings, and by the motor nose which rests on the truck bolster. The gear ratio is 4.375, there being 70 teeth on the gear and 16 teeth on the pinion, both of which are made of forged steel.

The control system

The speed and stopping and starting of the locomotive is controlled from either end of the cab. There are two control handles. One is a throttle lever which controls the output of the engines and the other is a master controller, or electric switch handle, which connects the traction motors in series or in parallel for either forward or backward movement. No rheostats are used in the power circuit.



Interior view showing the fuel oil injection pump and circulating water pump of one of the oil engines

In operation, the electric control handle is set for either forward or backward motion, with the motors in series for speeds below five miles per hour, or in parallel for speeds above five miles per hour. This regulation of the speed and tractive force delivered is illustrated by the speed-tractive force curve shown on the chart. The position of the throttle lever determines the power delivered by the engines, which is transmitted by the generators to the motors, automatically adjusting the relation of tractive force and speed to the load on the locomotive and also automatically changing this relation to suit the varying requirements of acceleration or the grade conditions.

Referring to the speed-tractive force curve on the chart, it will be noted that the locomotive develops a tractive force of 60,000 lb. at 30 per cent, the factor of adhesion maintained to approximately one mile per hour. At ten miles per hour the locomotive develops a tractive force of 15,000 lb.

The air brake equipment consists of the Westinghouse, schedule EL-14, straight and automatic air brake. The foundation brake rigging is designed to give a total brake shoe pressure of 60 per cent of the weight on the drivers with a 50-lb. cylinder pressure. The brake cylinder is 18 in. by 12 in. An air compressor for providing air for braking is installed in the cab. It has a piston displacement, when working against 130 lb. pressure and at 600 volts, of 100 cu. ft. per min. It will deliver air at a pressure of 90 lb. or 140 lb. per sq. in.

Principal dimensions and proportions of Long Island 100-ton oil-electric locomotive, No. 401

Builders	General Electric Company; Ingersoll-Rand Company; American Locomotive Company
Type	Oil-electric
Service	Switching
Weights on drivers	200,000 lb.
Wheel bases:	
Truck	7 ft. 2 in.
Total locomotive	36 ft. 2 in.
Oil engines:	
Number	2
Type	Ingersoll-Rand, 6 cyl., 4 cycle, vertical.
Rated capacity	600 hp.
Cylinders, diameter and stroke	10 in. by 12 in.
Speed	600 r.p.m.
Piston speed	1,200 ft. per min.
Fuel	Fuel oil
Generators:	
Number	2
Type	General Electric, Type TDC-6, 200 kw. d. c., 600 r.p.m., 600 volt
Exciter	6 kw., direct connected, 60 volt
Voltage, variation	200—750 volts
Motors:	
Number	4
Type	General Electric, Type GE-69-C, 200 hp., 600 volts
Capacity of fuel tanks	400 gals.
Length over couplers	45 ft. 10 in.
Diameter of wheels	36 in.
Size of journals	6½ in. by 12 in.
Tractive force	60,000 lb. at 30 per cent factor of adhesion maintained at approx. 1 m.p.h.

The running gear consists of two four-wheel, swivel, equalized trucks, each of which is equipped with a cast steel bolster and steel side frames. The side frames are carried on semi-elliptic springs to the equalizers which are in turn carried on the journal boxes. The journal boxes are of cast steel, pedestal type with A.R.A. bearing and wedge. With the exception of the truck equalizers, axles and that part of the traction motors carried on the axle, the entire weight of the locomotive is spring supported and equally distributed over the four pair of drivers. The axles are of forged open-hearth steel and have 6½-in. by 12-in. journals.

The locomotive is equipped with Leach type D-1 air operated sanders, arranged to sand in front of the leading truck for either direction of operation.

A Peter-Smith water heater and expansion chamber is provided to keep the cooling water from freezing when the engines are not operating and for circulating hot water through the radiators in the operator's compartments. Provision is also made for circulating hot water through the radiators from the circulating system of the oil engines.

THE SOUTHERN PACIFIC LINES has issued a small booklet entitled "The Motive Power of Western Development." The story is mainly a comparison of locomotives of today and yesterday. The history begins about 60 years ago, when the Central Pacific, the parent organization of the Southern Pacific, started its historic construction of the western portion of the first transcontinental railroad and indicates what the coming of the railroad and the constant improvements in its facilities have meant in developing the west.

Examples of recent locomotives of the 2-8-2 type

Arranged in order of weight

Railroad	D. L. & W.	C. & O.	C. & O.	C. R. R. of N. J.	A.T.&S.F.	Mo. Pac.	Wabash	C.R.R. of N.J.	Wabash	N.Y.C.	N.Y.C.	U.S.R.A.	West. Pac.	So.	Can. Nat.	L. V.	Canadian Pacific	F. E. C.
Road, class or number	2,148	K-2	K-3	896	4,000	1,565	K-3	919	K-4	H-10-A	H-10-B	Heavy	325	4856	S-2B	N 5B	5,355	711
Builder	Amer.	Amer.	Amer.	Amer.	Bald.	Amer.	Amer.	Bald.	Amer.	Lima	L. & A.	A. & B.	Amer.	Amer.	Mont.	Amer.	Mont.	Amer.
Ordered or built	1,923	1,924	1,924	1,924	1924	1924	1924	1924	1924	1923	1924	1918	1924	1924	1924	1923	1923	1925
Tractive force, engine, lb.	67,700	60,300	67,700	63,000	63,000	59,800	60,400	63,000	62,000	63,500	63,500	60,000	60,300	63,000	54,600	63,000	56,200	54,700
Tractive force, booster, lb.	11,500	10,700	.....	.....	......	10,900	10,900	......	......	11,200	11,200	......	10,900	......	10,700	11,000	......	......
Cylinder horsepower (Cole)	2,824	2,683	2,824	2,624	2,624	2,493	2,558	2,624	2,624	2,824	2,824	2,493	2,683	2,624	2,427	2,624	2,342	2,434
Speed m.p.h. at 1,000 ft. piston speed	35.16	37.5	35.16	35.16	35.16	35.16	35.7	35.16	35.7	37.5	37.5	35.16	37.5	35.16	37.5	35.16	35.16	37.5
Weight of engine, lb.	362,500	358,000	355,000	343,500	343,250	343,500	341,000	340,510	335,000	334,000	337,000	325,000	327,000	325,000	326,200	325,000	321,800	296,000
Weight on drivers, lb.	276,500	268,000	271,500	254,500	348,550	250,000	248,500	254,010	246,000	245,500	246,000	240,000	245,000	239,500	236,000	239,000	240,100	221,500
Weight on front truck, lb.	25,500	31,000	31,000	26,500	32,200	29,000	31,000	26,490	32,000	30,000	32,500	28,000	24,500	26,000	29,500	29,500	26,700	25,500
Weight on trailing truck, lb.	60,500	59,000	52,500	62,500	62,500	63,500	61,500	60,010	57,000	58,500	58,500	57,000	57,500	59,500	60,700	56,500	55,000	49,000
Weight of tender, lb.	216,500	219,100	217,600	188,000	36,750	188,500	196,500	209,800	194,500	199,700	276,000	172,000	191,600	187,600	194,200	197,500	228,300	256,700
Wheel base, driving, ft. and in.	17—0	16—9	16—9	16—6	16—6	17—10	16—9	16—6	17—10	16—6	16—6	16—9	16—6	16—9	16—6	16—6	16—6	16—9
Wheel base, engine, ft. and in.	37—4	37—5	37—5	37—1	35—0	37—5	36—6	37—1	39—1	37—0	37—0	36—1	36—3	36—11	35—9	37—1	35—8	36—11
Wheel base, engine and tender, ft. and in.	73—2½	76—0¾	76—5⅜	72—2½	72—8⅝	72—3½	71—3	76 8½	73—9½	71—6½	78—5	71—9½	73—2¾	71—8½	68—2	72—8¼	72—1½	76—11⅜
Cylinders, diameter and stroke, in.	28x32	28x30	28x32	27x32	27x32	27x32	27x32	27x32	27x32	28x30	28x30	27x32	28x30	27x32	27x30	27x32	25½x32	26x30
Driving wheels, diameter, in.	63	63	63	63	63	63	64	63	64	63	63	63	63	63	63	63	63	63
Steam pressure, lb.	200	190	200	200	200	190	195	200	200	200	200	190	190	200	185	200	200	200
Fuel	Bit. coal	Bit. coal	Bit coal	A.&B. coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Oil	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Oil
Boiler, diameter, first ring, in.	90 5/16	84½	87	84½	82	88	88	86 3/16	88	84 7/16	84 7/16	86	82	84½	76 5/16	90	78½	76⅝
Firebox, length, in.	120⅛	114⅛	120⅛	126⅛	114	114⅛	114⅛	126⅛	120⅛	114⅛	114⅛	120⅛	128⅛	120⅛	108⅛	120 1/16	120 1/16	114⅛
Firebox, width, in.	84¼	96¼	96¼	108¼	84¼	84¼	84¼	108¼	84¼	84¼	84¼	84¼	84¼	84½	84¼	90	84⅜	84¼
Tubes, number and diameter, in.	300—2	222—2	248—2	247—2¼	244—2¼	199—2¼	239—2¼	247—2¼	239—2¼	253—3¼	53—2¼	247—2¼	221—2¼	247—2¼	240—2	234—2¼	198—2¼	190—2¼
Flues, number and diameter, in.	50—5½	50—5½	50—5½	45—5½	45—5½	45—5½	45—5½	45—5½	45—5½	....	192—3½	45—5½	43—5½	45—5½	40—5⅜	50—5½	43—5½	45—5½
Length over tube sheets, ft. and in.	18—0	19—0	19—0	19—0	20—9	19—0	19—0	19—0	19—0	20—0	20—0	19—0	18—0	19—0	18—0	17—6	18—6	18—0
Grate area, sq. ft.	70.4	76.6	80.3	94.8	66.8	66.8	66.7	94.8	70.3	66.4	66.8	70.8	70.3	70.3	63.26	75.2	70.2	66.8
Coal rate, lb. per sq. ft. grate per hr. (Cole)	130	114	114.5	90	128	121	124.5	90	121	138	137.5	114.5	124	121	125	113.3	109	118.5
Steam required per hour—lb. (Cole)	58,750	55,800	58,750	54,600	54,600	51,850	53,200	54,600	54,600	58,750	58,750	51,850	55,800	54,600	50,500	54,600	48,700	50,600
Heating surface, firebox, total, sq. ft.	350	327	338	344	278	363	305	357	340	291	261	319	314	298	300	357	316	329
Heating surface, tubes and flues, sq. ft.	4,073	3,833	4,123	3,973	4,309	3,437	3,884	3,978	3,884	4,287	4,126	3,978	3,438	3,977	3,257	3,652	3,246	3,164
Heating surface, total evap., sq. ft.	4,423	4,160	4,461	4,317	4,587	3,800	4,189	4,335	4,224	4,578	4,387	4,297	3,752	4,275	3,557	4,009	3,562	3,493
Superheating surface, sq. ft.	1,112	1,173	1,173	1,050	4,162	1,051	1,051	994	1,079	1,215	2,020	993	932	1,050	885	1,074	973	991
Comb. evap. and super. surface, sq. ft.	5,535	5,333	5,634	5,367	5,749	4,851	5,240	5,329	5,303	5,793	6,407	5,290	4,684	5,325	4,442	5,083	4,535	4,484
Tender, water capacity, gallons	12,000	12,000	12,000	10,000	12,000	10,000	10,000	12,000	10,000	10,000	15,000	10,000	10,000	10,000	10,000	10,500	12,000	12,000
Tender, fuel capacity, tons or gal.	14	15	15	16	16	16	18	17	18	16	18	16	4,000	16	15	15	16	5,000
Weight on drivers ÷ weight eng. per cent.	76.1	74.9	76.5	74.0	74.6	73.0	72.8	74.6	73.4	73.5	73.0	73.9	75.0	73.9	72.4	73.6	74.6	74.8
Weight of drivers ÷ tractive force	4.08	4.44	4.01	4.04	3.95	4.18	4.11	4.03	3.96	3.87	3.87	4.00	4.06	3.80	4.32	3.79	4.27	4.05
Weight of engine ÷ cylinder hp.	128.4	133.5	125.7	130.9	136.7	143.2	133.3	129.7	127.6	118.2	119.3	130.5	121.8	123.7	134.5	123.9	137.3	121.5
Weight of engine ÷ comb. h. s.	63.7	67.1	63.0	64.0	59.9	70.6	65.0	63.9	63.2	57.7	52.6	61.5	69.8	61.0	73.8	64.0	71.2	66.0
Comb. heat. surface ÷ cylinder hp.	1.96	2.06	1.99	2.04	2.19	1.94	2.04	2.03	2.02	2.25	2.27	2.12	1.74	1.65	1.83	1.94	1.94	1.84
Tractive force ÷ comb. heating surface	12.23	11.31	12.01	11.73	10.96	12.32	11.52	11.82	11.70	9.99	10.96	11.35	12.87	11.83	12.29	12.38	12.38	12.20
Tractive force × dia. drivers ÷ comb. h. s.	771	713	757	740	690	777	737	744	748	630	691	715	811	745	774	781	781	769
Cylinder hp. ÷ grate area	40.1	35.0	35.2	27.7	39.3	37.3	38.3	27.7	37.3	42.5	42.3	35.2	38.2	37.3	38.4	34.9	33.4	36.4
Comb. heat. surface ÷ grate area	78.6	69.6	70.2	56.6	86.1	72.6	78.6	56.2	75.4	87.2	95.9	74.7	66.6	75.7	69.9	67.6	64.4	67.2
Firebox surface ÷ grate area	4.97	4.27	4.21	3.63	4.16	3.94	4.09	3.77	4.84	4.38	3.91	4.51	4.47	4.24	4.74	4.75	4.36	4.92
Firebox surface, per cent evap. h. s.	7.91	7.86	6.07	7.97	9.55	9.55	7.28	8.24	8.05	6.36	5.95	7.42	8.37	6.97	8.44	8.91	8.59	9.42
Superheat. surface, per cent evap. h. s.	25.2	28.2	26.3	24.3	25.3	27.7	24.92	26.5	21.4	38.9	45.0	23.1	24.8	24.5	24.9	21.1	27.3	28.1
Notes	a-g	a-g	a	a	b	a-d-g	a-e-g	b	a	b-g-k	a-g-k	b	a-g	a	a-g	a-g	a	a-d

Key to notes: a—Boiler diam. inside; b—Boiler diam. outside; d—Syphon; e—Feedwater heater; g—Booster; k—Type E Superheater.

Pennsylvania rebuilds steel freight cars at Enola

Units progress through the shop past repair gangs—Average daily output 36 cars—Sixty tons of material reclaimed in eight hours

On July 25, 1923, the first open top steel freight car was turned out of the Pennsylvania System Enola steel car shop located about five miles from Harrisburg, Pa. The shop was designed to repair 33 cars a day, this figure being reached in February, 1924. Since that time, the output has reached the mark of 40 cars a day, of 16 hr., which means that a car has been turned out on an average of every 25 min. The output has consistently averaged 36 cars per day. Up to January 18, 1926, 19,318 cars have been repaired in this shop.

At the present time the shop is set up to repair the Gs type low side, 100,000-lb. capacity gondolas and the Gla type, 110,000-lb. capacity, two-hopper cars. The daily output of these cars is on a one to two ratio; that is, two of the Gla type are repaired to every one of the Gs type. These cars are drawn from all over the system to receive heavy repairs. No minor repairs are made at this shop.

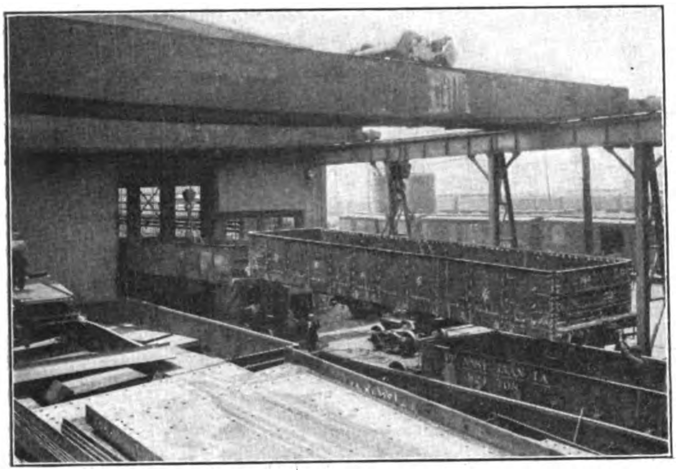
Organization of workmen

At present 881 men are employed at the Enola shop, including not only the repairmen actually engaged on the cars, but also the supervisors, clerks, stationary firemen, crane operators and directors, laborers, etc. The shops work three tricks, known as the A, B and C tricks, working from 7 a.m. to 3 p.m., 3 p.m. to 11 p.m. and 11 p.m. to 7 a.m., respectively. The A and C tricks are the two heavy tricks during which the repair work is done. During the B trick all the scrap is removed from the shops and enough new and reclaimed repair parts are brought in to supply the men on the A and C tricks. The gang foremen on the A trick supply the lists of material which must be placed in the shop during the B trick. During the B trick gangs work on the trucks, on the three 60-ton hydraulic gap riveters and on the side sheet, underframe and end jigs, as the shop output depends largely on these parts. The distribution of the

The Enola steel freight car repair shop, showing at the right the office and storehouse building

men on the three tricks actually engaged in repairing cars is shown in the following table:

Operation	Tricks A	B	C	Total
Foremen	1	0	1	2
Assistant foremen	2	0	1	3
Gang foremen	15	2	11	28
Acetylene cutters	6	0	6	12
Electric cutters	8	0	8	16
Acetylene welders	4	0	4	8
Reclaiming furnace	3	0	0	3
Reclaiming presses	18	0	0	18
Removing and dismantling drop doors	5	0	1	6
Repairing grab irons, ladder steps, etc	3	0	0	3
Dismantling cars	48	0	48	96
Truck repairmen	9	9	9	27
Repairing couplers and draft gears	2	0	2	4
Punch and shear	1	0	1	2
Drill press	1	0	1	2
Car oilers	2	1	1	4
Gap riveters (three machines)	9	9	9	27
Car side jigs	10	5	10	25
Drop door jigs	3	0	3	6
Longitudinal hood jig	3	0	3	6
Cross ridge sheet jig	3	0	3	6
Underframe and ends	9	8	6	23
Straightening parts on cars, applying end sills, couplers, cross ridges, sheets, longitudinal hoods, bottom floor sheets, etc	51	0	51	102
Assembling and fitting up ends, sides and floors	42	0	39	81
Pneumatic riveters	36	0	28	64
Finishing gang	16	0	11	27
Dismantling, cleaning, assembling and testing air brake equipment	15	0	14	29
Car cleaners and other work	12	0	0	12
Paint sprayers	7	0	0	7
Car stencillers	4	0	0	4



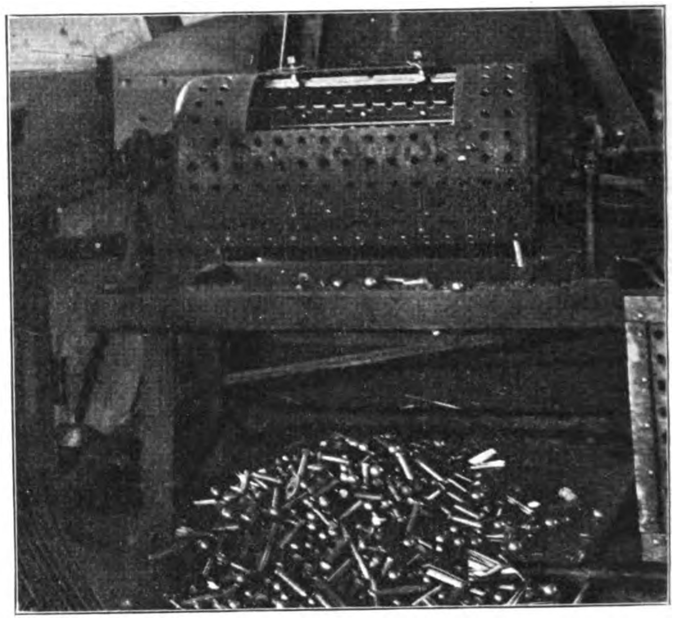
Lifting the car bodies with 15-ton cranes from the trucks after they have come from the rivet cutting shed. They are placed on benches for the dismantling gang

Following a car through the shops

The progressive steps by which a Gla, two-hopper type passes through the plant will be followed, for owing to its design, more work is required to rebuild these cars than is required to rebuild the Gs type gondolas.

Two 50-car length inspection tracks are located west of the rivet cutting shed. The cars are inspected by one inspector who marks the parts to be removed and replaced, repaired or condemned. The trucks are not inspected at this time. The inspector is followed by two men who list down all the work to be done which has been marked by the inspector. Cars are inspected only during the A trick.

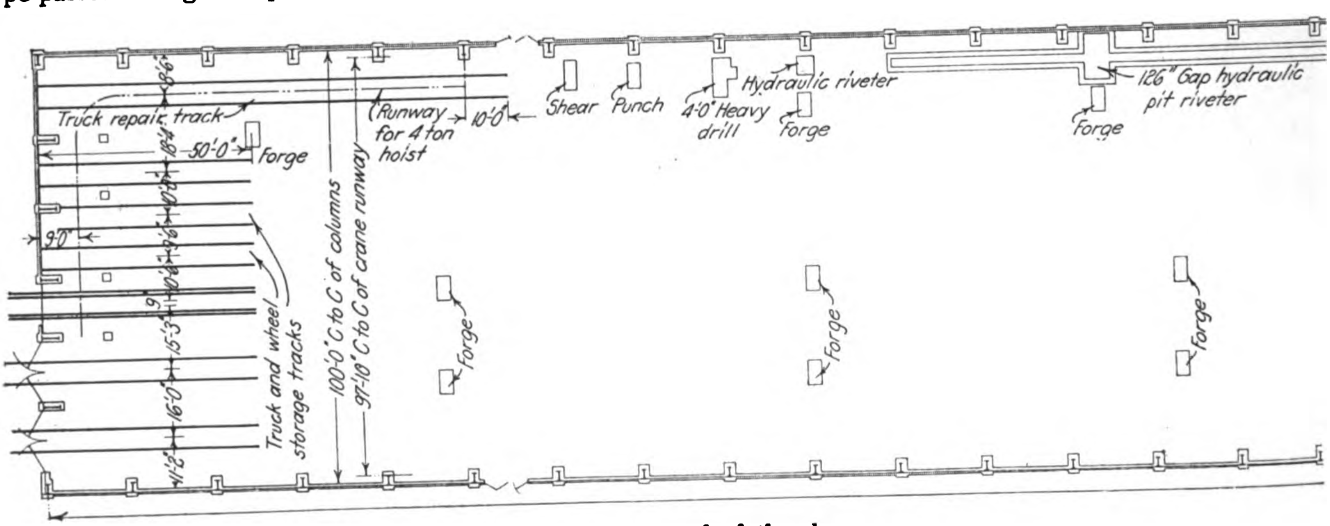
The cars are then moved to two tracks just outside of the west end of the rivet cutting shop at which point all dirt and refuse is removed by laborers. They are then pulled with an electric winch into the rivet cutting shed, which has two tracks, each holding eight cars. The shed is equipped with four electric arc welding sets and eight resistance units which travel on an overhead monorail ex-



Heated rivets which have been laid aside are reclaimed in this machine

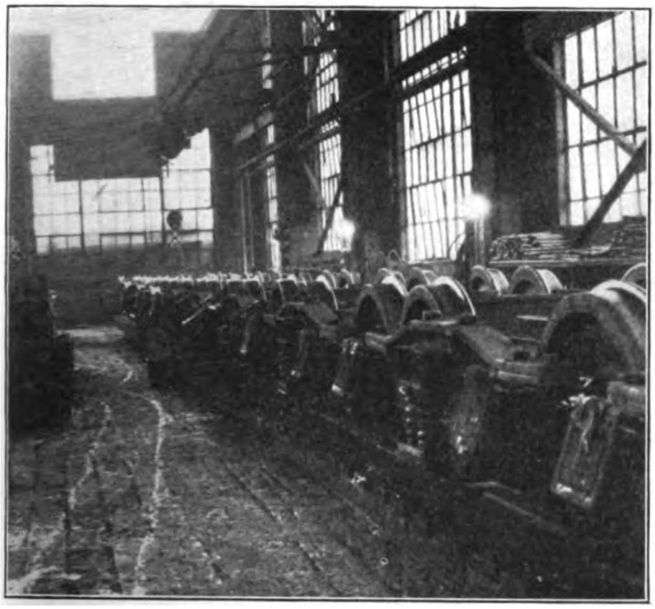
tending the length of the shop. Two operators can work from each machine. All rivet heads on vertical and sloping surfaces are cut off with the electric arc while those on horizontal surfaces are cut off with the acetylene torch.

The cars are then pulled out of the east end of the cutting shed by an electric winch. At this point the drop



The tear-down end of the shop

doors are removed and placed on a bench where the defective parts are removed and the bent parts straightened. The doors are sent into the shop to be repaired on jigs and replaced at the proper time. After the doors are removed each car body is lifted from the trucks and carried inside the shop by a 15-ton crane and placed on



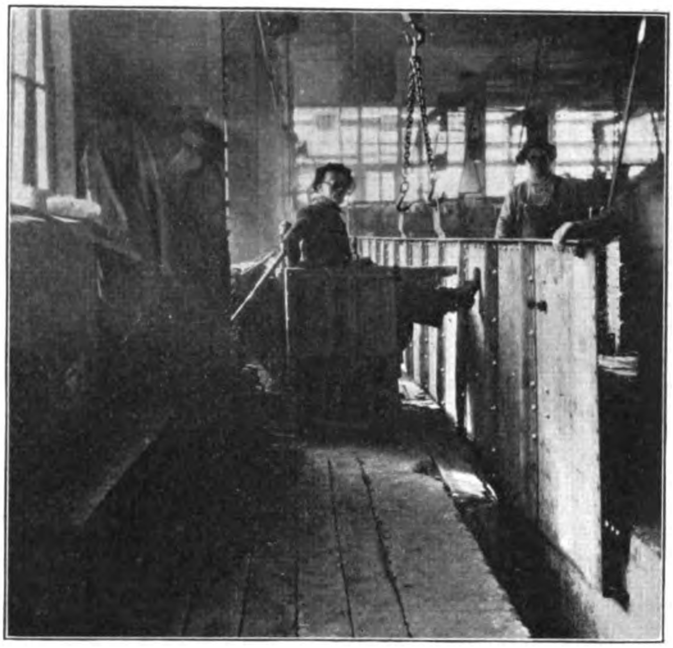
Truck repair track served by a four-ton overhead, mono-rail electric crane

benches for dismantling. There are 16 benches for this work.

The trucks are carried inside the shop and placed under a four-ton electric crane which runs on a monorail. Here the trucks are placed on a track holding five trucks which is raised 15 in. above the floor level for the convenience of the repairmen. The trucks are then completely overhauled, all parts being inspected by the gang foreman in charge. The body pins are pulled out by the four-ton crane, using a specially designed clamp. All journal packing is removed, cleaned and saturated with new oil before using again. After the trucks are repaired they are either placed under a car ready for the repair runways or are stored at the west end of the shop until needed. One laborer attached to this gang is kept busy picking up scrap material and placing it in metal boxes.

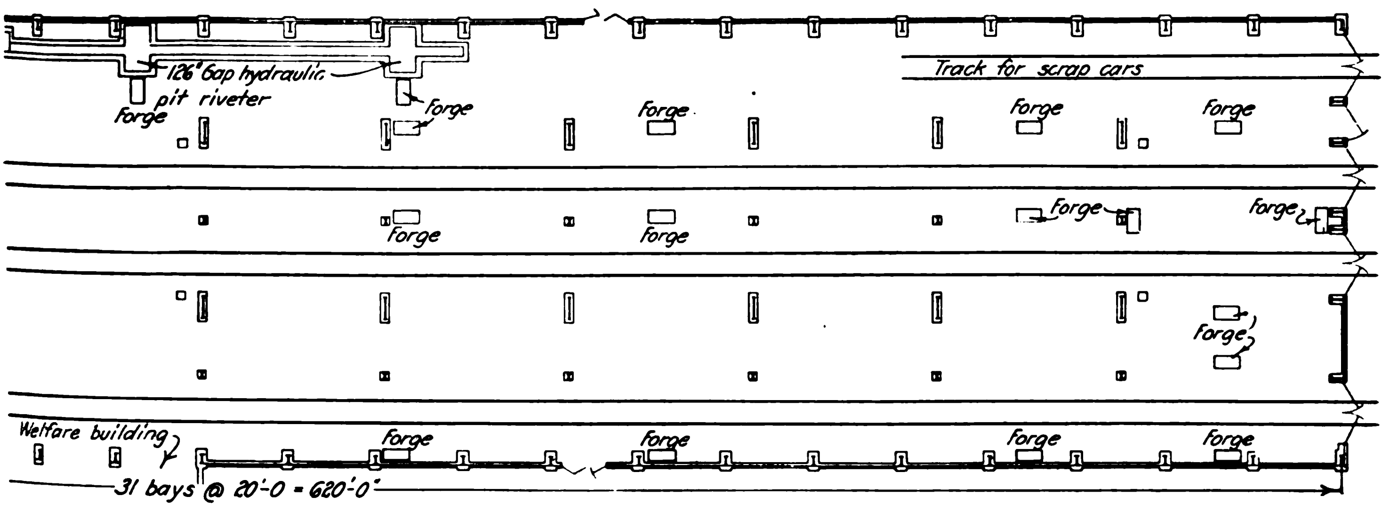
Coming back to the car body, which has now been brought into the shop, the first operation on the car is to dismantle it. This is done by the dismantling gang which backs out all the cut rivets and removes the parts marked for removal by the inspector. Sometimes there is nothing left of the car but a part of the underframe while other cars have parts of the sides and ends left standing. The foreman in charge now inspects those parts which were inaccessible to the outside inspector. He also makes the final decision as to what material is to go to the reclaiming department.

What is left of the car is then picked up from the dismantling position and placed on two repaired trucks at the head of the runways, 10-in blocks being placed over the side bearings of the Gs cars. It should be noted that the cars are run through the shop on their own trucks and not



One of the three 60-ton hydraulic gap riveting machines

on industrial trucks. It should also be pointed out that when the car body is placed on the trucks, it is turned so that the brake shaft end is always towards the east end of the shop. The reason for this is that the air brake parts, such as the cylinders, triple valves, etc., are always on one side of the track and that the material is placed



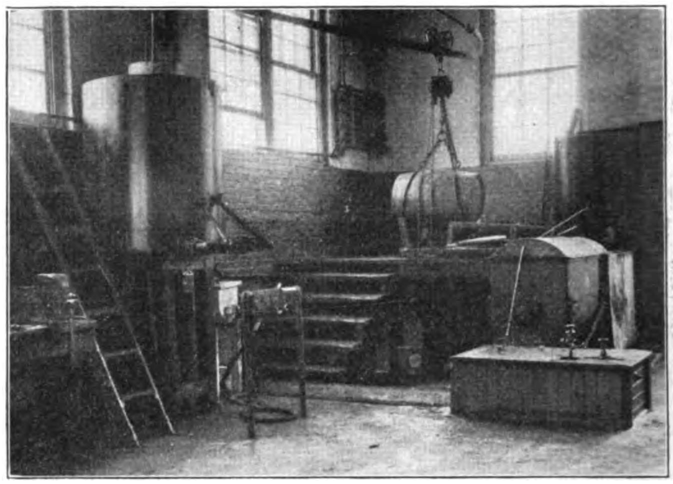
The arrangement of the set-up end of the shop

during the B trick so that it is on the side of the car to which it will be applied. This idea saves many unnecessary steps and all material has a place and is kept in that place.

There are three runways in the main shop, each of which is served by five two-ton overhead electric cranes. The cars pass through eight working positions as they move along these runways. In the first three positions all bent parts are straightened. The longitudinal hoods, cross ridge sheets, inside and outside hopper sheets, couplers, end and side sills, channels and diagonal braces are also applied in these positions. Enough rivets are

Spray painting crew which paints an average of 36 cars in eight hours

driven in these positions to secure the parts so that they will not fall off as the car is moved to the riveting position. The parts are straightened, hot or cold, on the car. To facilitate the cold straightening of parts, a unique method is used to tie the cars down to the rail when using a jack. Pieces of 90-lb. rail, 4 ft. 10 in. in length are laid in the ground at intervals at right angles to the track. They are placed right side up. Two heavy turnbuckle tie rods are used, one end of each of which consists of a clamp which fits over the ball of the rail. The other ends of both rods pass through a heavy flat piece of steel, which is placed across the end sill and held in place by nuts on the ends of the rods. The device is drawn tight by two square threaded turnbuckles. This arrangement securely holds the car to the rail. To further facilitate the straightening process, other pieces of 90-lb. rail have been placed in the same manner under the tracks but

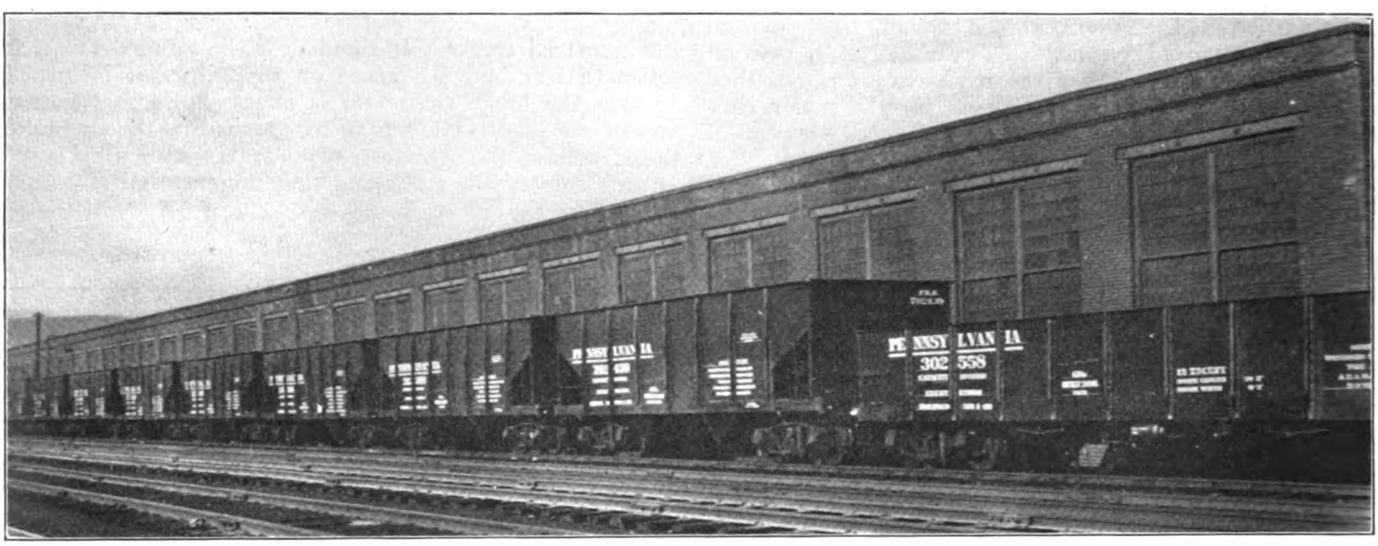


Equipment used for mixing the paint for the spraying machines

are inverted so that the base of the rail is exposed. This surface provides a solid foundation on which the jacks are placed.

The car is then moved by hand to the fourth and fifth positions on the runway where the ends and side sheets are picked up by two-ton cranes and held in position until they are pinned and key-bolted to the cars. In the sixth position all reaming is completed. This is done by electric motors.

The seventh is the waiting position where the cars are held until the riveting gang is ready for them. They are moved from here to the eighth position by an electric winch. Here the car stands between four oil rivet heating furnaces, two on each side of the track. The riveting gang is divided into four groups of three men each.



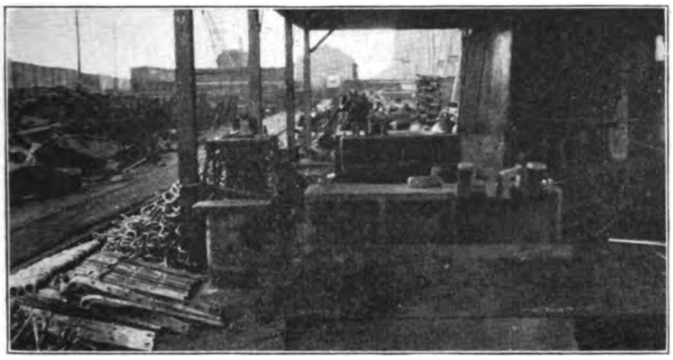
The finished product outside of the paint shop

After the riveting is completed, the cars are pulled outside the shop by an electric winch where the finishing gang applies the drop doors, door operating parts, brake shafts, steps, adjusts the coupler heights and does other miscellaneous work. All the air brake equipment is then

applied and tested. The car is then ready for the paint shop.

The paint shop

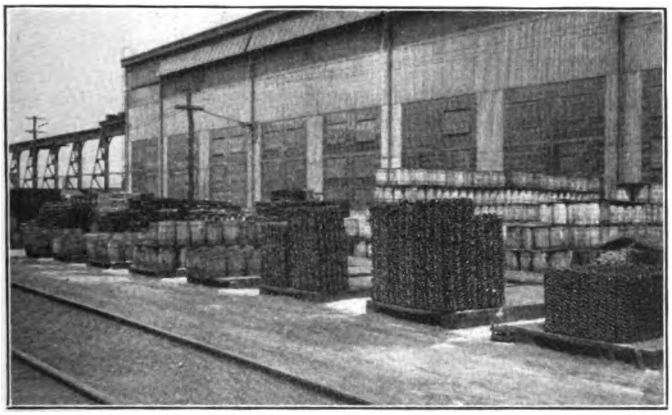
The cars are moved by a shifter to the paint shop which is located about one mile east of the main shop. It contains eight tracks, each holding 15 cars, or a total of 120 cars. When necessary, the cars are cleaned with substitute turpentine and wire brushed. The average workman will clean from five to six cars a day. The cars are then paint sprayed by machines. Six men are employed to spray the cars, the average workman spraying ten cars a day. The second coat of paint is applied as



Jigs used for repairing hand holds, ladder treads and drop door hinges

soon as the first coat is dry. The cars are then light weighed and stenciled as soon as the second coat is dry.

The old method at some shops of marking the lines on a car for stenciling consisted of taking a notched stick and holding the lower end flush with the bottom edge of the car side and then making a chalk mark at each notch. Then the stick had to be used as a ruler to scribe the guide lines.

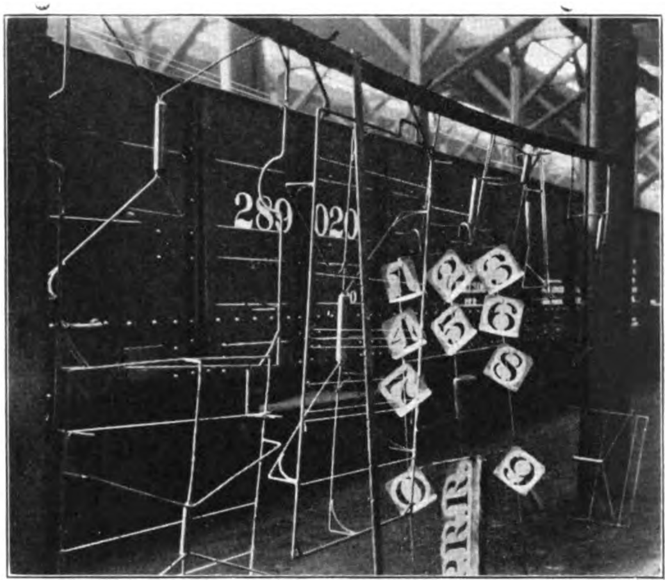


The orderly method of piling material outside of the shop greatly assists in placing material in the shop during the B trick

An effective marking device used at this shop as shown in one of the illustrations, has reduced the time required for stenciling by the old method by one-half. This device, called a line finder, consists of a steel frame made of 1/4-in. round material welded together. Cords are properly spaced on the frame. When used the cords are first whitened with chalk after which the frame is hung over the side of the car by means of two wire hooks. The workman then simply snaps the proper strings to make the guide lines desired.

In the average railroad shop the painters carry their stencils in a tray. When they want to use them, considerable time is lost in sorting them out and dirt quickly collects among them. At Enola the stencils are hung on pegs on a rack made of light material. Thus, they are always in full view of the workmen and are kept out of the dirt.

During the year of 1925, 9,276 cars were painted in this shop and a large quantity of paint has to be mixed. By means of the equipment, shown in one of the illustrations, one man thoroughly mixes 700 gal. of paint in eight hours. This formerly required six men and then it was not fine enough to be used properly in the spraying machines. The equipment consists of an electrically driven 300-gal. mixing tank. The barrels, which contain the pigments, are lifted by a chain hoist and held in position to drain as shown in the illustration. The paint is first mixed by a screw conveyor which carries the paint to the next mixing tank which contains two cylindrical mixers. The coarse mixer consists of 48, 3/8-in. round iron rods and the fine mixer, 76, 3/8-in. rods, both driven at 150 r.p.m. After the paint is thoroughly mixed, which requires about 20 min., it is drawn off and passed through



This view shows the stick formerly used for laying off the stenciling lines and the frame now used—The frame for holding stencils is also shown

a strainer and then syphoned by an air driven pump into a 330-gal. storage tank shown at the left of the illustration. This tank contains an air motor driven shaft to which is attached four paddles. The purpose of this is to keep the paint continually agitated so that the heavy pigments will not settle to the bottom of the tank. The paint is drawn off through two outlets into the spray machine tanks.

Outside of the paint mixing building, buried in the ground, is a 7,000-gal. linseed oil storage tank and a 5,000-gal. turpentine storage tank. Pipes lead from these tanks into the paint mixing room through which the liquids are drawn by an air motor-driven syphon pump.

All the waste and rags used about the paint shop for cleaning cars and wiping off paint are reclaimed in washing machines. The equipment for washing and drying waste and spraying machines is located directly in front of the paint mixing building. The waste washing machine consists of an iron tank, 6 ft. long, 2 ft. wide and 2 ft. deep. It is partitioned at the middle. A steam and water pipe leads into each section. In each section are three

vacuum cups and a box which contains the washing compound. The cups are moved up and down by an air motor-driven crank shaft. Each charge consists of 200 lb. of waste which is left in for four hours after which it is removed, rinsed in cold water and dried on top of a brick arch oven which is oiled fired. The furnace, which is made entirely of brick, will hold its heat for 14 hours and will dry 200 lb. of waste in eight hours, depending on weather conditions. The waste can be reclaimed at 2½ cents a pound.

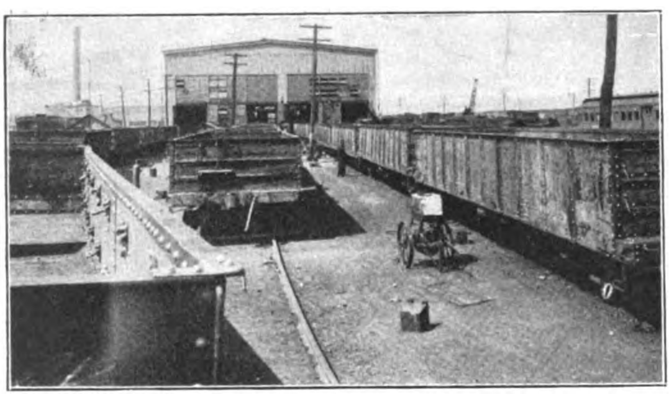
Besides using waste for cleaning the cars, 18-in. square pieces of burlap bag are used. The stores department saves up its burlap bags and sends them to the paint shop where they are cut up to the proper size and stored in the basement of the paint mixing building until needed. The spraying machines are washed out in a steel lined brick basin located to the south of the waste drier. It consists of a basin large enough to hold one sprayer. The lye bath is heated with steam in the winter and oil in the summer. It requires about two hours to thoroughly wash out a spraying machine.

Reclaiming material

After the cars are dismantled in the shop, all the material is again inspected. Those parts which can be reclaimed are brought out, during the B trick, to the reclaiming plant located at the north side of the rivet cutting shed. This department reclaims 60 tons of material in 8 hours with equipment consisting of three 30-in. and four 18-in. presses, one furnace and several jigs for reclaiming hand holds, ladder steps, drop door hinges and cross tie braces. Much of the work is straightened cold while some is heated and reclaimed.

Cross tie braces are reclaimed in large quantities. The ends are first cut off with the acetylene torch and then the remaining part is straightened under the presses. They are then held at each end in an air-operated clamp at which time new flanged ends are riveted on. Ladder steps and drop door hinges are straightened in the jigs shown in one of the illustrations.

Another illustration shows a device for reclaiming



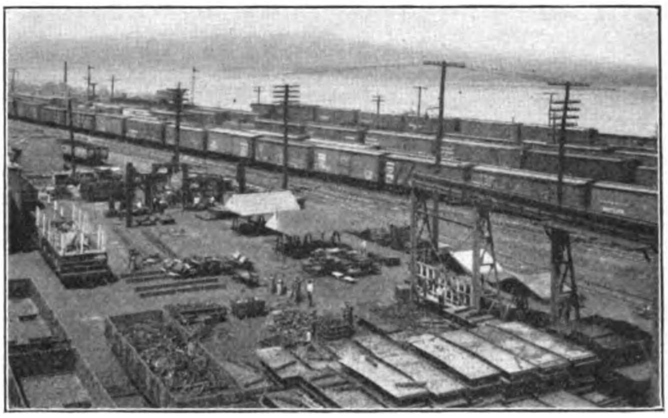
View of the east end of the shop showing the cars coming out after they are repaired, ready for the paint shop

rivets which have been heated, but for various reasons were laid aside. It consists of an old air reservoir which has 22 rows of ½-in. holes, 15 holes in each row, drilled around its circumference. The rivets are put in this cylinder together with pieces of broken reamers and the whole lot is rattled for about 20 min., with the result that all the scale is removed and the rivets are as good as new.

The plant has some by-products for which scrap credit is given, helping to reduce the costs. An average of 180,000 lb. of sheet steel scrap and 90,000 lb. of miscellaneous scrap accumulates each day the shop works, which well illustrates the magnitude of the operations. The scrap is usually loaded in the Gs type gondolas. In order to pile the scrap high in the car it was the custom in the past to use lumber as side boards. The lumber used in each car cost approximately $15. Now, scrap side stakes from Gla cars are used in place of the lumber. They eliminate the usage of lumber and are sold as part of the scrap. This means a considerable saving as three cuts of scrap are loaded each day.

Assembling car parts on jigs

The assembling and riveting of the car sides is an operation in itself. The car sides are bolted together and



View of the straightening and reclaiming plant where 60 tons of material are reclaimed in eight hours

reamed on a jig made of angle irons. There are two of these jigs which are kept busy during all three tricks. Five men on a jig build up from 16 to 18 sides in eight hours. The jigs are served by a revolving electric jib crane. The sides are then moved to the hydraulic gap riveters by electric cranes. The gap riveters are also served by a mono-rail electric crane.

Jigs are used for building up center sill splices, drop doors, applying the inside hoppers to the longitudinal hoods, car ends and web plates. Some of these jigs are outside of the north side of the building. An industrial track runs along this side of the building and the built-up parts are placed on trucks and run in the shop under the cranes, which pick them up and place them at the station assembling these parts. This track relieves the 15-ton shop cranes from a great deal of work and generally speeds up the operation. This arrangement of the jigs on the outside saves considerable floor space in the main shop. The jigs are under cover on the outside so as to protect the workmen.

Saving of floor space

Floor space is conserved as much as possible. At various points in the shop, metal scrap boxes are placed under the floors. A small trap door about 12 in. square is removed and the small scrap material is passed through the opening. When the boxes are full, they are removed by a crane through a large trap door and another immediately put in its place.

Although the work in a steel car repair shop is probably more hazardous than that in any of the other various railway shops, there were only 18 accidents resulting in lost time at Enola during the last eight months of 1925. This commendable record was obtained as the result of a unique safety first campaign which will be described in detail in a later issue of this magazine.

Car orders placed during 1925

Freight equipment ordered is considerably less than 1924—Passenger car requirements the same as in previous years

THE orders for freight cars placed during 1925 for service in the United States total, according to compilations of the Railway Age, 92,816 cars. This figure, compared with 143,728 ordered in 1924, with 94,471 in 1923, and with 180,154 in 1922, shows that the 1925 total was considerable below normal. During the greater part of the year, the freight car market was practically stagnant. It later revived to the extent that about one-half the year's orders were placed after October 1. On the other hand, the orders placed for passenger cars during 1925 for service in the United States totaled 2,191. This, compared with 2,554 in 1924, with 2,214 in 1923, and with 2,382 in 1922, shows that the requirements of the railroads for passenger car equipment have been practically the same since 1921, when only 246 passenger cars were ordered. These totals do not include the orders for rail-motor cars, details concerning the orders for which are incorporated in another article in this issue.

The orders for freight cars placed by Canadian purchasers with Canadian builders totaled only 642, this light business being similar to that in 1921 and 1922 as shown in Table I.

None of the Mexican railways placed orders for freight equipment during the past year, but a considerable number of cars were exported to oil and mining companies in South and Central America. The International Railways of Central America placed orders for 306 cars of miscellaneous freight equipment, and the Consolidated Railroads of Cuba ordered 325 freight cars last year. These two orders were the largest exported for railroad service. The total export business amounted to 2,138 cars.

Table I—Orders for freight cars since 1918

Year	Domestic	Canadian	Export	Total
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	105,552
1924	143,728	1,367	4,017	149,612
1925	92,816	642	2,138	95,596

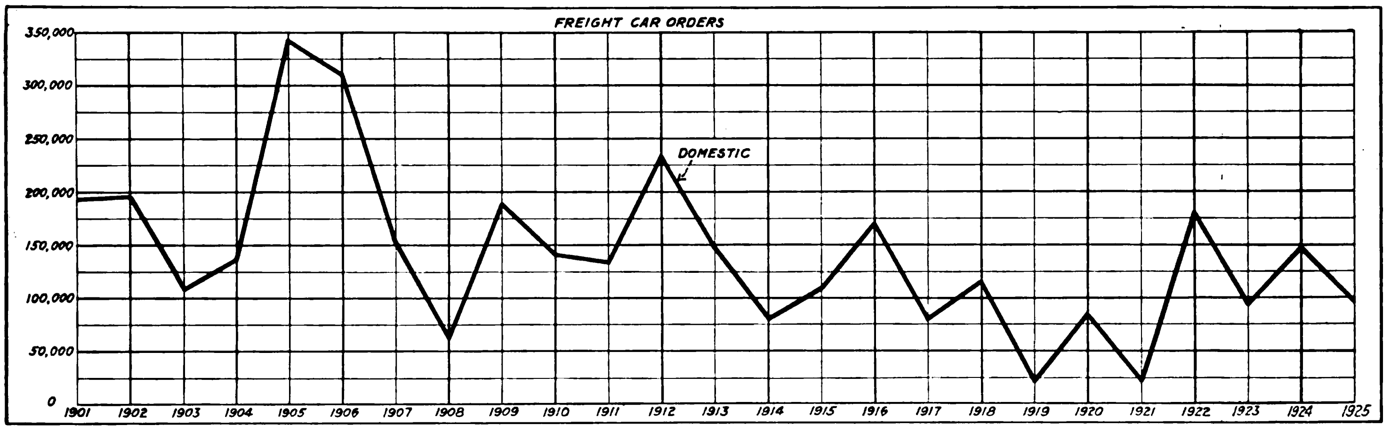


Chart showing the number of freight car orders placed each year from 1901 to 1925

Freight car production in 1925—as distinguished from orders placed—totaled 105,935 cars as compared with 113,761 cars in 1924. Orders for the first nine months of the year totaled only 45,000 cars, or an average of but 5,000 cars a month. In June and July orders were reported for about 800 cars each.

During the entire year the railroads continued to report a substantial surplus of cars in good order. The surplus at its lowest point did not fall below 100,000 cars, although in October, the largest volume of business in the history of the railroads, measured in net ton-miles, was moved. Table II shows the number of freight cars built for domestic and foreign service in the United States and Canada since 1913.

The largest freight car order placed during the year 1925 was by the Baltimore & Ohio, which ordered a total of 10,100 cars. The Chicago, Milwaukee & St. Paul was also a heavy purchaser of freight equipment, ordering a total of 6,500 freight cars, of which 1,000 were single-sheath automobile cars and 3,000 single-sheath box cars, all of 80,000 lb. capacity. The Cleveland, Cincinnati, Chicago & St. Louis ordered a total of 4,300 freight cars of which 1,500 were gondolas of 110,000 lb. capacity. Other large purchasers included the Delaware, Lacka-

Table II—Freight cars built in 1925

	United States	Canada	Total
Domestic	105,935	.....	.....
Foreign	3,010	.....	.....
	108,945	.....	.....

	United States			Canadian			Grand
	Domestic	Foreign	Total	Domestic	Foreign	Total	total
1913	176,049	9,618	185,667	22,017	.....	22,017	207,684
1914	97,626	462	98,088	6,453	.....	6,453	104,451
1915	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916	111,516	17,905	129,421	.....	.....	5,580	135,001
1917	115,705	23,938	139,643	3,658	8,100	11,758	151,401
1918	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919	94,981	61,783	156,764	6,391	30	6,421	163,185
1920	60,955	14,480	75,435	.....	.....	.....	.....
1921	40,292	6,412	46,704	8,404	745	9,149	55,853
1922	66,289	1,126	67,415	458	100	558	67,973
1923	175,748	2,418	178,166	.....	.....	.....	.....
1924	113,761	1,141	114,902	1,721	.....	1,721	116,623
1925	105,935	3,010	108,945	.....	.....	.....	.....

wanna & Western, 1,475; the Great Northern, 1,827; the Louisville & Nashville, 3,250; the Missouri Pacific, 3,000; the New York Central, 5,650; the Norfolk & Western, 3,528; the St. Louis-San Francisco, 4,000; the Southern Pacific, 3,800; the Union Pacific, 1,026 and the Wabash, 2,039. The largest order placed in Canada was for 525 by the Canadian National.

The types of freight cars ordered for service in North America are shown in Table III. None of these cars are of unusual capacity. The railroads ordered more box cars than any other type, of which there were a total of 31,037, or 33.2 per cent of the total ordered last year. Of the open top cars, there were more gondolas ordered than any other type. Orders placed in 1925 for gondola cars totaled 23,317, or 25 per cent of all the freight cars ordered.

Comments on design

After many vicissitudes of letter ballots, recommendations and modifications, the A. R. A. single-sheathed box car has been approved as recommended practice. Two designs of the proposed A. R. A. standard double-sheated box car were submitted to letter ballot and adopted by a large majority. A number of steel sheathed cars with wood lining have been in service for some time and the committee is awaiting service reports before resubmitting the question of adopting these cars as standard to letter ballot. The designs covering steel frame cars with wood sheathing and lining of 40 and 50 tons capacity were the ones adopted as recommended practice.

Table III—Types of freight cars ordered in 1925 for use in the United States and Canada

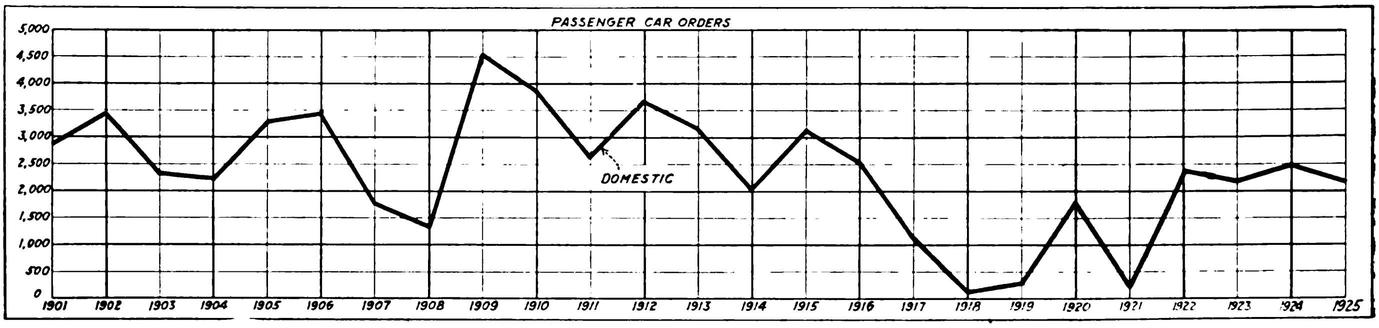
Type	Number	Per cent
F.—Flat and logging	3,359	3.5
G.—Gondola	23,317	25.0
H.—Hopper	7,546	8.2
R.—Refrigerator	7,358	7.8
S.—Stock and poultry	3,156	3.4
T.—Tank	4,582	4.9
X.—Box	31,037	33.2
Automobile	10,016	10.7
Ballast, dump and ore	1,873	2.0
Not classified	660	.7
N.—Caboose	571	.6
Total	93,475	100.0

Passenger car orders

Railways in Canada reported orders for only 50 passenger train cars. This is the smallest number of cars that have been ordered by Canadian railways since 1918, as shown in Table IV.

A total of 76 passenger train cars were ordered for export of which 32 were for the International Railways of Central America and 27 were for the Havana Central, Cuba.

The production of passenger train cars for domestic service in the United States totaled 2,363, as compared with 2,150 in 1924. While it is true that the railroads have had substantial losses in their passenger traffic, this loss has been in the short-haul business. The railways have reported satisfactory long-haul passenger traffic, and the orders for 1925, as shown in Table V, include a total of 535 sleeping, parlor and chair cars, or 23.9 of the total passenger equipment ordered. In addition, the railroads ordered a total of 112 dining cars or 5 per cent of the total, which added to the preceding figure, makes a total of 647, or 28.9 per cent of the total cars ordered for service in long-haul passenger traffic. This figure, of course, does not include the number of coaches that may have been ordered for long-haul business.



Passenger car orders, 1901 to 1925

The largest single order for passenger equipment was placed by the Pennsylvania when in July it distributed orders for 357 cars, of which 122 were baggage and express cars, among various builders. The Pennsylvania's passenger car orders for the year totaled 375. Early in December, the New York Central placed the year's second largest order, a total of 274 cars. This road was also in the market at various times during the year and placed orders for a total of 418 passenger train cars. Orders placed by neither of these roads, however, exceeded the total of the new equipment authorized by the Pullman Company, which amounted to 568 cars. Referring to Table V, it will be noted that only 10 express refrigerator cars were ordered in 1925 as compared with 410 in 1924, and 400 in 1923. Table VI shows the number of passenger cars built in the United States and Canada for domestic service and for export.

Table IV—Orders for passenger cars since 1918

Year	Domestic	Canadian	Export	Total
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679
1925	2,191	50	76	2,317

Table V—Types of passenger equipment ordered for use in the United States and Canada

Type	1923	1924	1925
Coach, combination, passenger, etc.	736	952	650
Multiple unit coaches and trailers	...	...	82
Sleeping, parlor, chair, etc.	488	543	535
Dining	76	133	112
Baggage, express, mail	415	555	739
Express refrigerator	400	410	10
Milk	323	12	80
Horse	16	34	16
Private, business, miscellaneous	15	15	17
	2,469	2,654	2,241

Developments in 1925 tend to provide increased comfort for passengers

Competition for passenger traffic has been an incentive to the railroads to improve their facilities for travelers.

especially for long-hauls. Many of the "crack trains," have been re-equipped during the past year. Special attention has been given to the interior arrangement. There has been a tendency, especially in dining and parlor car equipment, to eliminate all moulding as much as possible and to finish the interior walls with such material as plain Cuban mahogany without any inlay or ornamentation. A feature of many of the cars of this type is the lighting arrangement and design of the fixtures. Evidence that considerable attention has been paid by the designers to the necessity of having the lighting fixtures harmonize with the scheme of interior decoration is shown in the cars that have been built during the past year.

Table VI—Passenger cars built in 1925

	United States	Canada	Total
Domestic	2,363	.....	.....
Foreign	50	.....	.....
	2,413	.....	.....

	United States			Canadian			
Year	Domestic	Foreign	Total	Domestic	Foreign	Total	Grand total
1913	2,559	220	2,779	517	.....	517	3,296
1914	3,310	56	3,366	325	.....	325	3,691
1915	1,852	14	1,866	83	.....	83	1,949
1916	1,732	70	1,802	37	.....	37	1,839
1917	1,924	31	1,955	45	.....	45	2,000
1918	1,480	92	1,572	1	.....	1	1,503
1919	306	85	391	160	.....	160	551
1920	1,272	168	1,440	....	.....	....	.....
1921	1,275	39	1,314	361	.....	361	1,675
1922	676	144	820	71	.....	71	891
1923	1,507	29	1,536	....	.....	....	.....
1924	2,150	63	2,213	167	.....	167	2,380
1925	2,363	50	2,413	....	.....	....	.....

The demands on the railroads by the increase in suburban business has also required a special study of the equipment used in this service. The outstanding developments in suburban cars in 1925 were incorporated in those built for the Boston & Albany. These cars are now in service on the main line and the Highland branch between Boston, Mass., and Riverside and have a seating capacity of 100. The features in the design of these cars are the ample space provided at each end of the car for standing room, the wide end doors and wide steps with four treads. The seats have no arms which aids considerably to the ease of passage through the aisle and entrance into the seats. A description of these cars was published in the May, 1925, issue of the *Railway Mechanical Engineer.*

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for bulged car sides

The Bessemer & Lake Erie, on December 18, 1923, furnished an inspection certificate to the Pittsburgh, Shawmut & Northern, requesting disposition of P. S. & N. car No. 6446 under A. R. A. Rule 120, the car being reported damaged in ordinary service, because it had a bulged side when picked up at Pittsburgh Junction which became gradually worse in service so that when it arrived at North Bessemer it was no longer safe to clear adjoining tracks. The car owner declined to furnish disposition on the ground that the B. & L. E. did not furnish specific information as to conditions under which the damage to the car occurred as provided in the footnote of A. R. A. Rule 43. An inspection of the car was made by a representative of the car owner who contended that the nature of the defects indicated unfair usage or derailment, which would probably bring the case under Rule 112. The handling line pointed out that the car was 16 years old and that the records did not show that it had ever received any important repairs except for the application of draft arms. It maintained that the car was moved under load in a train which had no derailment or unfair usage to this or any other car. The handling line further stated that it had complied with all the requirements of Rule 43 by explaining to the owner that the car bulged in ordinary service between specified points on the road. The car owner stated that the B. & L. E. did not furnish sufficient information relating to the origin of the damage and as the owner had made extensive repairs to the car five months prior to the time it was reported for disposition, it decided to inspect the car. Following this inspection, the handling line failed to furnish a statement explaining fully how the damage occurred, to which the owner insisted it was entitled under the footnote of Rule 43, but suggested an inspection by some disinterested car inspectors. The owner declined to be a party to this suggestion but such an inspection was conducted by the handling line in conjunction with two neutral roads. Two different statements furnished by the handling line indicated that its representatives were confused in their own minds as to how or when the damage occurred.

The Arbitration Committee rendered the following decision, "The handling line, having failed to furnish the car owner the information required by the note under Rule 43, should assume responsibility. Arbitration Cases 1219 and 1283 are parallel."—*Case No.* 1344, *Bessemer & Lake Erie vs. Pittsburgh, Shawmut & Northern.*

Responsibility for the application of wrong triple valve

On November 2, 1922, the Louisville & Nashville rendered its repair cards to cover the repairs to San Antonio & Aransas Pass car No. 8191. Among other items covered by repair cards were the following:

N. Y. F.—1 triple R. & R., out of date.
Cyl. C. O. T. & S.—Rule 60, S.A.A. P.6-21 at Ykm.
Not stencilled for style valve. Date built, April, 1913.

On December 3, 1922, the card was returned to its owners at which time a joint evidence card was made stating that the New York F-1 triple valve should have been made a Westinghouse K.-1 triple valve. The car owner after correcting the wrong repairs originally made, submitted to the Louisville & Nashville, the joint evidence together with the billing repair card with the request that a defect card be furnished for the application of a wrong triple valve. The Louisville & Nashville declined to issue a defect card on the ground that, inasmuch as the repair card included information showing that the car was not stencilled to maintain a K-1 triple valve and that the joint evidence card did not show that the car was so stencilled, the evidence not conclusive that wrong repairs were perpetuated. The car owner contended that it was not a requirement of the interchange rules to include on joint evidence cards, properly secured under Rule 12, information showing the stencilling on cars to support the evidence of a disinterested inspector that improper repairs existed. The information to the effect that the car was stencilled was, however, later added to the joint evidence card, but the Louisville & Nashville did not consider this addition to the joint evidence card several months after the improper repairs were corrected as acceptable or as invalidating its original record

of repairs which makes special mention that the car was not stencilled for the type of valve standard to the owner's car.

The Arbitration Committee rendered the following decision: "The Louisville & Nashville Railroad is responsible for the wrong triple valve, in accordance with the joint evidence furnished."—*Case No.* 1346, *San Antonio & Aransas Pass vs. Louisville & Nashville.*

The lubrication of car equipment*

A discussion of methods and practices found effective in reducing hot box troubles—Emphasis on trained forces

By G. E. Dailey

Supervisor of lubrication, Chicago, Burlington & Quincy, Chicago

WE are all agreed on the fundamental principles necessary to obtain desired lubrication and reduce the number of hot boxes. But are we pursuing the right course? Hot boxes are not eliminated at meetings or in offices, but in the train yard and on the repair tracks. If the number of hot boxes are to be decreased and the cost incident thereto lessened, we who are supervising lubrication must go out into the field with the oilers, packers and inspectors; teach them if necessary the proper methods to follow, not only during the time an epidemic is present but all the time, constantly keeping before them what a hot box really costs and not lose sight of the fact that we should make the oiler feel that he is an important cog in this machine. I recall when the oiler or packer was considered non-productive, or in a class with the common laborer, and invariably during the time of retrenchment, these men were about the first to be reduced. This false impression is disappearing fast, and we realize these men are highly productive.

A well-trained force of oilers and packers will reduce the number of car men on a repair track who are engaged in changing wheels on cars that have been set out on account of cut journals caused from hot boxes. Hot boxes may result from a number of causes but the most common ones which we meet with every day are defective wedges, top of oil boxes worn, cracked bearing linings, and packing settled or rolling away from the back or fillet ends of the oil boxes.

Oil of a good quality and packing that will stand up to the journal is necessary if good lubrication is to be obtained. With these furnished, the cause of hot boxes in most cases is improper maintenance. We expect the oiler in transportation yards to condition the boxes so trains can be moved with prompt dispatch. The point of origin is the proper place to service treat a journal box, and the kind of treatment given is an important factor in effecting good lubrication.

Method of treating boxes

I recommend the following treatment of boxes, which has been the means of increasing the miles per hot box:

Remove the front plug, place the packing iron in the bottom corner of the box between the metal and packing; pushing the iron two-thirds of the way back, turn it towards the journal and then push it back to the extreme end of the box. This replaces the packing that has rolled or settled away from the journal. Pull the iron out and repeat on the opposite side of the box. Place the iron in the box on top of the packing and level it up, working the packing down to the center of the journal. Finish the box by tucking the packing snugly against the collar. Replace the front plug in a loaf form, avoiding the use of a knife so it will not be interlaced with the main body of the packing. This treatment requires about five minutes to the side of a car and is confined to cars that are at freight houses, elevators, coal mines, and those that are not made up in trains.

At intermediate or passing stations where trains are on hand but a short time, the ordinary running inspection only can be made; this, however, should be done in a thorough manner. Lids must be raised and the packing iron placed in the back end of the box to ascertain if the packing is in place. Under no condition pass up a box that has a hole in the packing at the back end. We all agree that it would be best to set the car out in preference to letting it go forward in this condition, as a hot box is sure to develop.

Boxes with the packing riding against the top of the box and against the brass are very common conditions. If we would ask the question, "Why do we lag a steam pipe or put on an overcoat," our answer would be, "To keep the heat in." Knowing this to be a fact, why do we permit overpacking of oil boxes. I have found hundreds of boxes where the packing was wedged tight against the box on both sides of the journal, and many up to the top of the box, obstructing the only possible means to radiate the heat generated by the journal. You no doubt have seen oilers adding small balls or shoving short pieces of packing into the corner of the box in order to fill up a hole in the packing. This practice should be discouraged, and in the event it is necessary to use packing, use a piece the thickness desired and work it into the box in the same manner that would be done if a box were entirely repacked. Working it in uniformly not only takes care of the missing packing, but will also raise it to the desired height. Small bits of packing carelessly applied are easily dislodged, and in a short time it is rolling against the sides of the journal, serving as a wiper and destroying lubrication.

The greatest evil that we have to combat at the present time is the piece of packing that is placed lengthwise of the journal in a twisted or rope form and not connected with the main body of the packing. This is always dry and, resting against the journal at the rising side, constantly serves as a wiper for the oil that is picked up from saturated packing under the journal. I believe everyone knows, or should know, that packing

*Abstract of an address presented at the regular monthly meeting of the Western Railway Club held at the Hotel Sherman, Chicago, on January 18.

placed in this manner, since it is not being interlaced with the packing under the journal, never attracts any of the oil from the bottom of the box and invites a hot box.

We have too many oil box lids defective to such an extent that it is impossible in many cases to open them. When an oiler comes upon a box in this condition, which cannot be opened, he will as a rule pass it up for the time being, fully intending to return and give it attention after he has worked the balance of his train, but before he has an opportunity to get back, the train has departed. If it runs hot, it is up to the trainmen out on the road, who will set the car out in preference to delaying the train unreasonably. A talk with almost any trainman will bear this out and emphasize the importance of repair track forces maintaining box lids in first class condition.

Proper tools are essential to carry on this work. No oiler or packer should be permitted to work with a packing iron having a blade of less than 14½ in. in length, so he can get to the back end of any size oil box. It will surprise one how many irons are in use that will not reach the back end of the box. Packing hooks and a bucket should also be carried. Without a hook, improperly packed or disarranged packing cannot be given proper treatment. In my opinion this explains to a certain degree the large number of overpacked boxes in service today.

The oiler, being a busy man, concentrates on the condition of the packing, and is apt to overlook other mechanical defects that contribute to hot bearings. Therefore, when trains reach inspection points the inspector should lift all lids and inspect for low, broken brasses and slipped lining, and see whether or not the wedges are in place. An inspector should feel the ends of the journals with his bare hand and not pass along the train merely feeling the tops or sides of the boxes, as is so often done.

A dry spot on the journal end gives warning

An approaching hot box usually gives warning through the dry spot developed at the collar end of the journal around the lathe center hole. Hot boxes in many cases are a long time in the making. Defects under the brass and under the packing which cannot be detected through ordinary inspection run a long distance before the journal becomes hot enough to smoke, but the excessive friction causing heat will go to the center and out the end of the journal, burning the oil around the center, which produces a dry spot, the best tell-tale known of a prospective hot bearing. When a journal is found in this condition, do not pass it up. Stop and pull the packing; carefully examine it to see if it is glazed or dry, especially at the fillet end; examine the brass on the wedge where it will be found in most cases that either a waste grab has just started or a wedge is carrying all the weight either at the back or front of the journal, and in many cases the entire surface of the wedge is worn flat. Any one of these conditions will produce a dry center, and in a short time a hot box.

The salt and pepper treatment, or poking at the front of the box is responsible for a large per cent of our hot boxes, and must be discouraged if we expect to improve the situation.

Assuming that the oil box is filled with well lubricated packing resilient enough to stand up to the journal, it should run indefinitely before it becomes necessary to apply any additional packing. However, before the car leaves the terminal, the oiler will give the front plug a poke and partly wedge it under the journal. Perhaps the oiler may add a little more plug if he deems it necessary, as the average man feels that a plug large enough to cover the collar is necessary. This same treatment will take place four or five times every 1,000 miles. Finally the packing is so tight that it glazes and prevents capillary attraction of the oil to the journal.

The use of free oil is a subject of frequent discussion and various opinions. Oil companies tell us, and I think we all agree, that only a very thin film of oil gets between the bearing parts, which prevents them from coming in contact with each other, no matter how much oil is placed in the box. However, a study of packing conditions will show that about one box out of every twelve could stand a little oil, especially on cars that have been standing around for a few days. It is my opinion that a little oil used judiciously will prevent many hot boxes and ultimately reduce the cost of lubrication. It is true that boxes in this condition should be repacked with fresh packing, but anyone familiar with train yard operations will readily see how inconsistent this is, if we expect to get over all the boxes.

Free oil test successful

At a terminal where a through service treatment was possible, the free oil can was given a test, and I am advised that the cars that were set out of trains en route on account of hot boxes were reduced from an average of about 250 cars per month to 45. The cost of the free oil during this test amounted to approximately 50 cents per day. These are train yard problems and will effect a reduction in hot boxes if religiously followed.

Annual re-packing of journal boxes helps solve the hot box situation. Cars that are in service with a date of last repacking twelve months old should be placed on repair tracks, the packing pulled and thoroughly renovated, the oil boxes, brasses and wedges examined and the trucks tightened up.

A campaign of this kind on any railroad will bring out defects such as brasses with cracked lining, flat or broken wedges, and worn tops of oil boxes. Notwithstanding that these same cars may be running cool at the time, when put under a maximum load they will fail. The wedge plays a very important part in lubrication and I feel that the sooner we scrap worn flat wedges, the quicker we will get relief.

The top of a new A. R. A. wedge has a 78-in. radius. This places the weight assigned to the journal on the center of the wedge, which is distributed equally over the brass. Lack of the oscillating motion, for which the wedge is designed, will cause the brass to bind, producing excessive friction and eventually a hot bearing. The same is true when the top of the oil box is worn. All wedges should be positioned by the lugs in the oil box, which are for that purpose. Never use a bar or other tool to force them in place if it can possibly be avoided. Too often brasses are changed and a worn flat wedge reapplied; the latter no doubt is the original cause of the hot box.

Walk up and down almost any repair track and you will find at least 25 per cent of the wedges unfit for service. All worn out or defective wedges should be broken at the time of removal, so that it will be impossible to reclaim. Unless this is done my experience has been that most defective wedges work back into the stores department.

Brasses must have a smooth surface, broached and free from hard spots. I often wonder what the result would be if we would fit other bearings as we do the freight car brasses. It is not unusual to see brasses put on the journal and no attention paid to see whether they are getting any kind of a bearing. Brasses are applied with bad nicks or rough spots, and in many cases without any oil. I believe if a little more time were taken and a crown bearing obtained about two inches wide the full

length of the bearing an improvement would be noticeable.

The foreman or wheel checker should personally see every wheel change made and know that the journal is perfectly smooth and free from abrasions, that brasses and new accurately fitted dust guards applied. Wheels on the same axle must be of the same diameter and mounted to center. Do not have bent axles or tapered, undersize or oversize journals. Journal turning lathe operators can cause no end of trouble if the journals are turned taper with rough collars or fillets. These conditions are not intentional but often due to eagerness to get output.

The finishing cut taken on a journal should be a very light one, so that it can be rolled smooth, free from scabs or burs which are visible if closely inspected. When these scabs separate from the journal and remain between the hearing contacts, they will cause excessive friction and overheat the bearing. When an oil box is applied, use air if it is available, to clean out the interior thoroughly of scale, sand, fine particles of waste or any other foreign matter. A new brass applied without enough lateral, the ends riding on the fillet, causes trouble; for this reason, be sure a correct size is used. Solid brasses should always be sounded with a hammer to ascertain if the lining is tight. Poor tinning and throwing brasses around causes loose lining and other undesirable results.

Journal packing reclamation

Lubricating costs can be materially reduced by installing adequate facilities to renovate old journal packing. We must abandon the idea that most any old plant is good enough to reclaim dope, and the railroads that have seen this mistake and installed more modern plants, have already noticed an improvement in their cost, including a reduction in the number of hot boxes on all equipment.

During the past eight months I have had the opportunity to see old inadequate plants replaced with the more up-to-date ones, and it is remarkable the transformation that has taken place, not only in making the workmen happy and contented, but in the increased efficiency. In some cases forces have been reduced 50 per cent, to say nothing of the improved condition of the renovated packing. Packing plants should be light and well ventilated, vats and machines installed and arranged so that no extra steps are necessary. A packing plant can be put up at a nominal cost, semi-fireproof, built out of condemned car bodies, size 18 ft. by 40 ft., which, I believe, is large enough to take care of the average repair point.

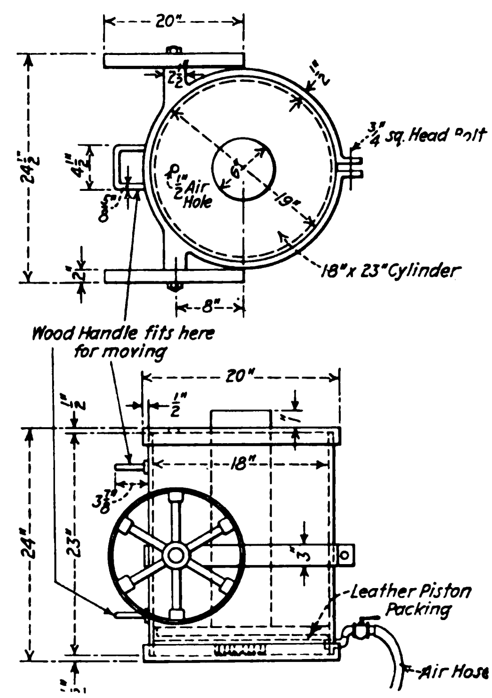
Centrifugal wringers and mechanical tumblers should be a part of the equipment in every reclamation plant, and will improve the grade of packing 100 per cent. Hand picked packing has never been a success. I find the most convenient plant is the one that is constructed so that only the attendant is allowed plenty of room to work.

The old packing is received through a chute into a warming vat. After being thoroughly warmed, it is placed in a mechanical tumbler and turned for five minutes at speed of 18 r.p.m. Then it is removed and placed in a washing vat, and swished back and forward with a pitchfork, then placed on a drain board until it has thoroughly drained. After this it is returned to a vat containing new or filtered oil, again placed on a drain board and kept there until it contains about 3½ pints of oil per pound of waste. Storage vats with drain valves at the bottom are used, and as fast as the oil drains off the packing, it is drawn from the vat and poured back over the packing, maintaining a uniform mixture at all times.

Oil filters should be a part of the equipment in the packing plant, and the oil analyzed periodically to know that it is fit to be used. Very good filtered oil can be obtained from a filter made out of an old oil drum or something similar. Apply two pieces of front end netting 14 in. apart, the lower netting about the same distance from the bottom, placing new waste between them. The netting is compressed, but not tight enough so that the oil will not flow freely. Add a steam coil in the bottom to heat the oil to about 100 deg. F. Oil put through a filter of this kind will test out about two per cent suspended matter.

Portable air jack for car repair shops

A PORTABLE air operated jack for raising cars clear of the trucks is shown in the drawing. It consists essentially of a 18-in. cylinder made of ½-in. sheet metal. The piston rod is 6 in. in diameter. The jack is carried



Drawing showing the construction of a portable air jack

on two cast iron wheels attached to the cylinder by a band which can be slipped on and clamped in the most convenient position. Loops for inserting a wooden handle are riveted to the side of the cylinder.

A Correction

The article entitled "Causes and Prevention of Freight Car Derailments," which appeared on page 23 in the January issue of the *Railway Mechanical Engineer,* was signed by T. H. Symington and his business connection was given as president of The Symington Company, Baltimore, Md. This information was erroneous as T. H. Symington has not been connected with The Symington Company since the reorganization of the T. H. Symington Company in 1924.

Locomotive repair shop labor saving devices

Development of machine attachments, cutting tools and jigs encouraged at the Houston, Texas, shops of the Southern Pacific Lines

AT Houston, Texas, is located the principal locomotive repair shop on the Southern Pacific Lines in Texas and Louisiana. They consist of two enginehouses and a 14-pit erecting shop. In order to reduce the machine time on various jobs; to easily handle irregular parts; to obtain the maximum production from the machine tools available and to reduce the maintenance costs of locomotives, many labor saving devices such as jigs, fixtures, cutting tools, or machine attachments are used in these shops.

The following article contains a description of a few of the devices which have exceptional merit.

Practical jigs

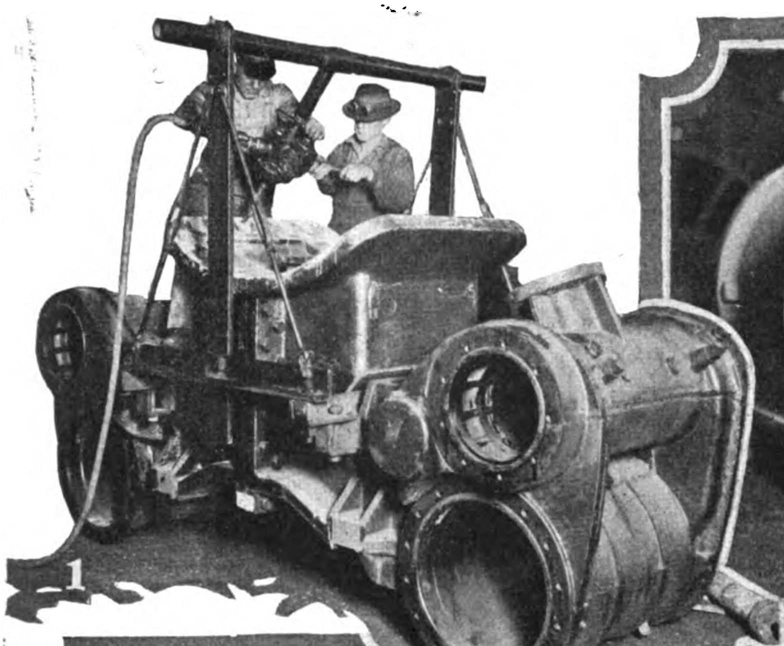
The usual practice, when drilling cylinder saddle holes, is to use an old man which requires considerable time to move about the saddle, to say nothing about the hard work involved. Considerable time is saved at the Houston shops by using the jig shown in Fig. 1. Its base consists of four heavy angle irons, two of which fit into the saddle frame fit. The two which pass across the front and back of the saddle are bolted to the ends of the others. An iron upright is bolted to the center of each of the transverse angle irons. A circular crossbar of heavy tubing passes through the ends of these uprights and on the bar is mounted a sliding pipe tee. This framework is held rigidly in place by four truss rods, two on each end of the cylinders. The center line of the circular crossbar is adjusted by means of the turnbuckles, to coincide with the center of the saddle radius. The feed screw of the air motor fits into the extension of the sliding tee, so that the operator may place the drill radially at any point on the saddle with one set-up.

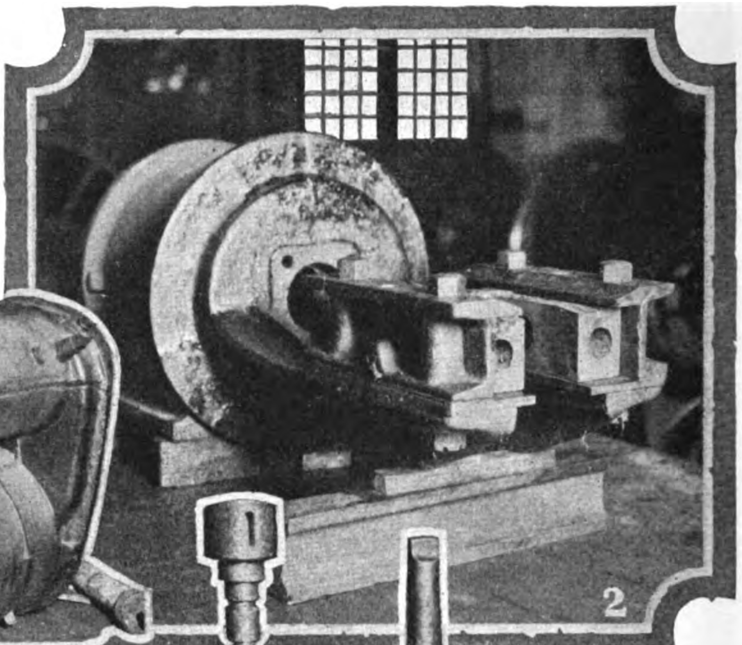
If valve crosshead guides are not properly lined up with the valve stem, undesired distortion will result. To overcome this trouble, the jig shown in Fig. 2, has been made for lining up these parts. It consists of a 14-in. air brake cylinder, the bottom head of which is bored out to the same size as the stuffing box on the back steam chest head. Through the hole in the stuffing box and the hole in the brake cylinder head, a mandrel is placed to which the standard valve crosshead is attached. The guides on the steam chest heads are then lined to the crosshead. This method insures correct alinement when the parts are placed on the locomotive.

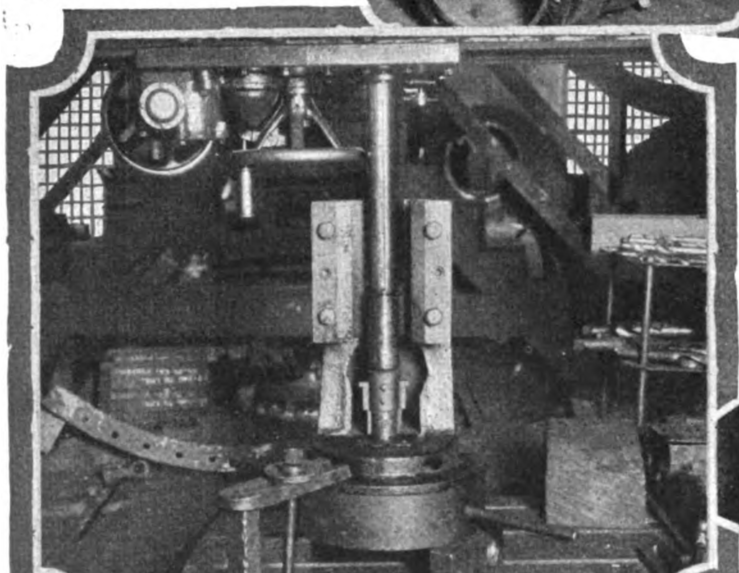
Fig. 3 shows a jig used for boring out the back steam chest head stuffing box. The jig consists of a cast iron shell, the bottom of which is bushed to fit the boring bar. The top is bored out to take the cylinder fit on the back steam chest head. The jig is set on two parallel strips on the table of a radial drill press. The steam chest head is then placed in the jig and the whole is held on the table by two clamps. A 3-in. cutter is placed in the boring bar. The smaller diameter of the cutter makes the roughing cut while the larger diameter makes the finishing cut. At the same time it forms the joint for the gland and also acts as a stop for the depth of the cut. This is a simple and quick method of boring out an awkward casting.

By using properly designed jigs or fixtures, some of the work on the lay-off table can be eliminated and still secure accuracy in the finished work. A splendid example of such a fixture is shown in Fig. 4, the purpose of which is to drill, ream and fit the bolts in a Walschaert valve link and trunion blades at one set-up, the top blade being the only part laid off. The usual practice is to lay-off and drill each piece and then ream the holes to fit the bolts. As will be seen from the photograph, the three parts of the link are held in position by the trunions which are held in a three-part jig. The knee of the jig at the rear is bolted to the table of a radial drill press. The trunions are held in place by the

two caps which are drawn tight by four studs. Thus, the two trunions are lined up to a common center line. The ends of the trunion blades can now be quickly lined up for machining. This is done by placing parallel strips under each end of the link. The blades are lined up and held in place by two clamps, one at each end of the work. Parallel strips are placed between the blades and the link to prevent the springing of the trunion blades when the work is clamped. The four bolt holes can now be drilled, reamed and the bolts fitted at one set-up.







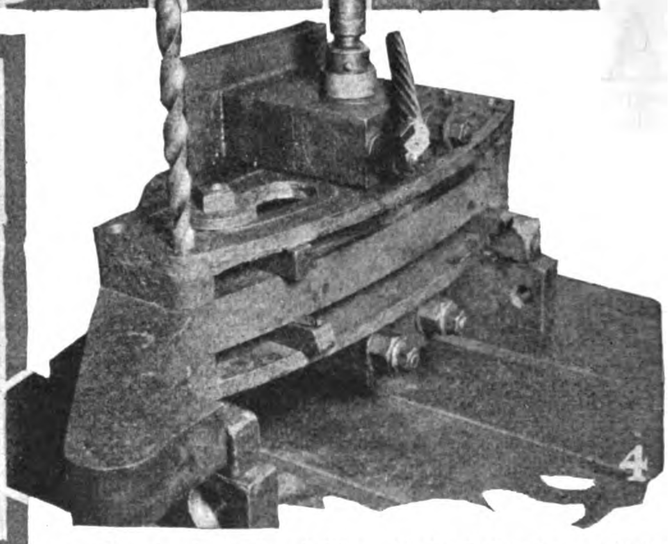


Fig. 1—A jig for drilling all the holes in a cylinder saddle at one set-up; Fig. 2—A jig for lining up the steam chest head guides to the valve crosshead; **Fig. 3—A jig used for boring out the back valve chamber head stuffing box; Fig. 4—A jig which eliminates considerable lay-off table work when drilling, reaming and fitting the bolts in a Walschaert link**

Machine attachments

Both time and power are lost on the return stroke of a planer. The planer attachment shown in the photographs and drawing, Figs. 5 and 6, utilizes this lost time and power. The tee portion of the device is machined from a solid piece of steel. The shank is 3 in. square and 12¾ in. long. The four cutting tools, two for the forward and two for the return stroke, are held in tool posts fitting into blocks which swing on ¼ in. per ft. standard taper pins. The surface of the blocks are knurled to prevent the tools from slipping. The tools are fed by hand. This attachment is used on crosshead shoes, 22 of which are shown set up in the planer in the photograph.

After a pair of wheels has been properly quartered on the quartering machine, it is good practice to true up the crank pins while the wheels are set up in the machine centers. Fig. 7 shows a turning tool on the end of the quartering machine boring bar. It is arranged so that two tools can be used if desired. The tool holder is placed on the bar with a taper fit to insure proper alinement.

Many shops are not equipped with a radius grinder for grinding the radii of Walschaert and Stevenson valve

gear links. However, most shops are provided with some type of internal grinder which can be used for grinding these parts if the proper machine attachment is provided. Figs. 8 and 9 show respectively a photograph and a drawing of such an attachment which is used at the Houston shops on a Madison cylinder grinder. The frame work consists of four vertical columns, the ends of which support a steel plate in the center of which is a bushed hole. Through this bushing passes a vertical column which is in the plane of the spindle center. A horizontal arm slides on this column to which it is clamped by two set screws. The end of the arm carries a pendulum, slotted for adjustment in length to correspond to the radius of the link. As the sides of the link are square, it is a simple matter to line up the link to the desired grinding position on the face plate. The circular rod which extends down from the end of the pendulum cross arm to the link is used for measuring the radius of the link while grinding. The rod is provided with a graduation so that it can be readily adjusted to the desired radius of each class of locomotive link. At the lower end of the pendulum is a face plate to which the link is clamped. Back of the face plate at the lower end of the pendulum is another heavy vertical plate, the lower end of which is fitted with a rack and mounted in a tee-slot of the grinder which permits it to move back and

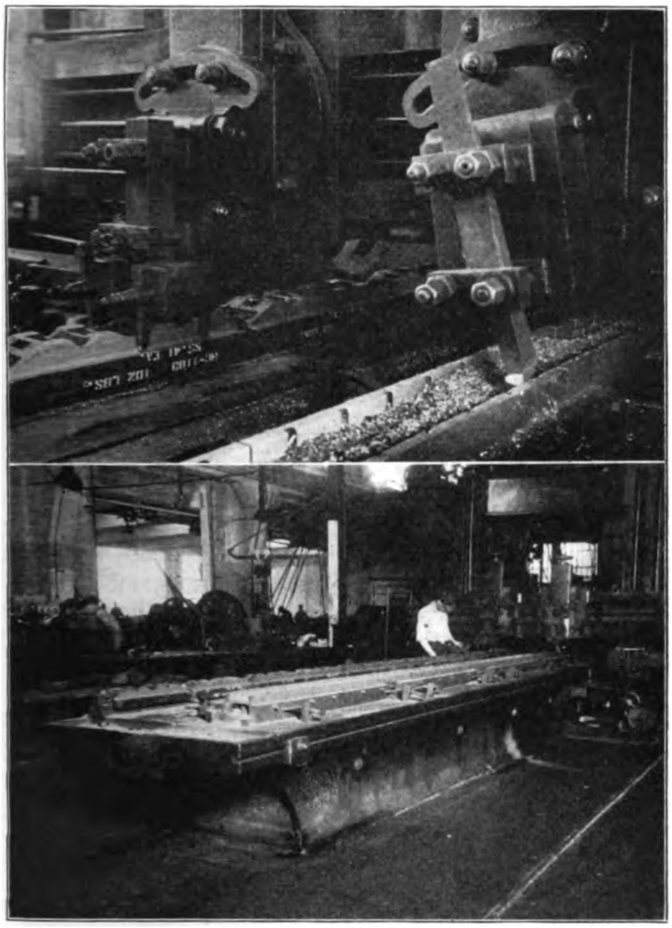


Fig. 5—The upper view shows, at the left, the arrangement of four tools for cutting in the return stroke of the planer—The lower view shows 22 crosshead shoes set up on the planer

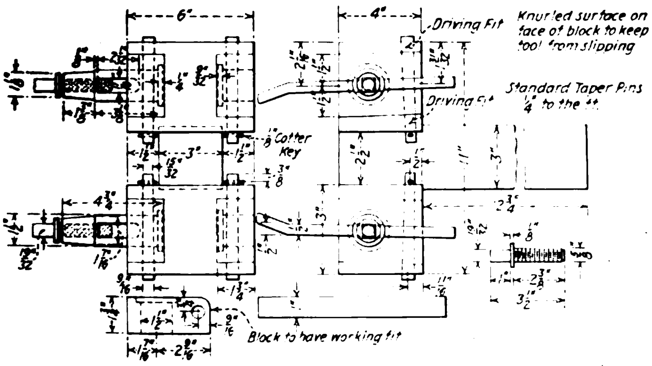


Fig. 6—Detail arrangement of tool used for cutting on the return stroke of the planer

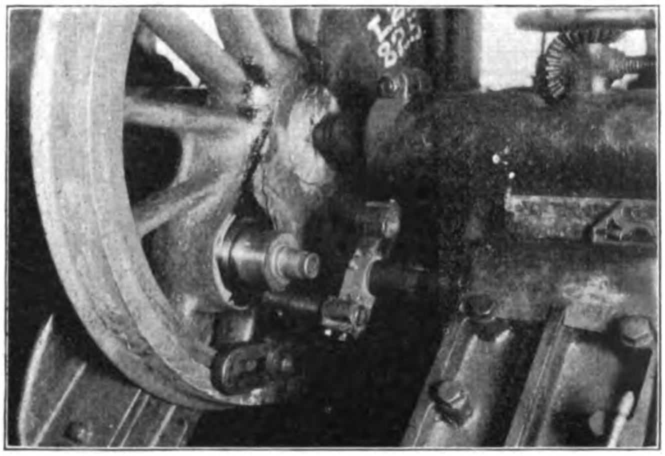


Fig. 7—Method of truing up a crank pin on a quartering machine

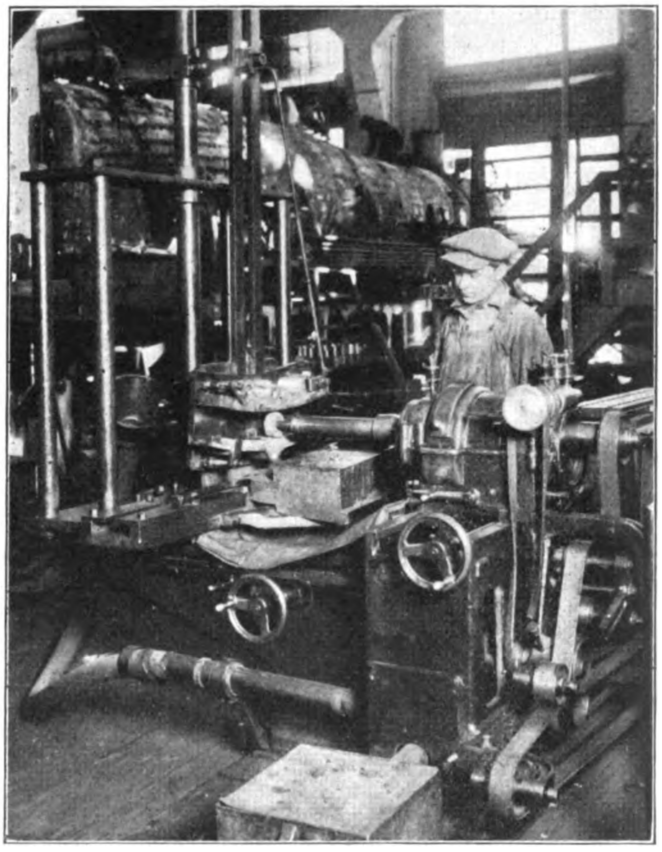


Fig. 8—Attachment used on an internal grinder for grinding the radius on a valve link

forth transversely to the grinder spindle. A pin projecting from the back of the face plate fits in a vertical slot in the rack plate and the latter is traversed by the revers-

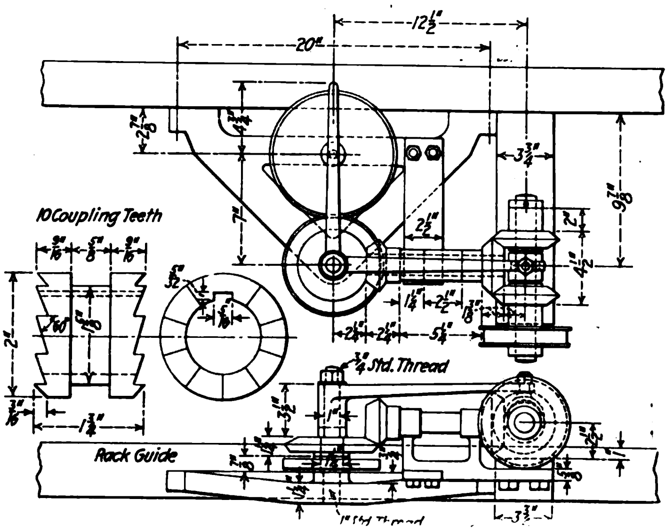


Fig. 9—Reversing mechanism of attachment for grinding the radii of valve links

ing mechanism shown in Fig. 10, the large gear meshing with the rack. The reverse lever is actuated by adjustable dogs on the rack plate. The device is belt driven.

an engine lathe with comparative ease. The reverse shaft is first placed on the lathe centers. The attachment, which consists of a train of three gears held together in a frame, is bolted to the lathe carriage. The tool holder consists of a circular gear ring which is slipped over the

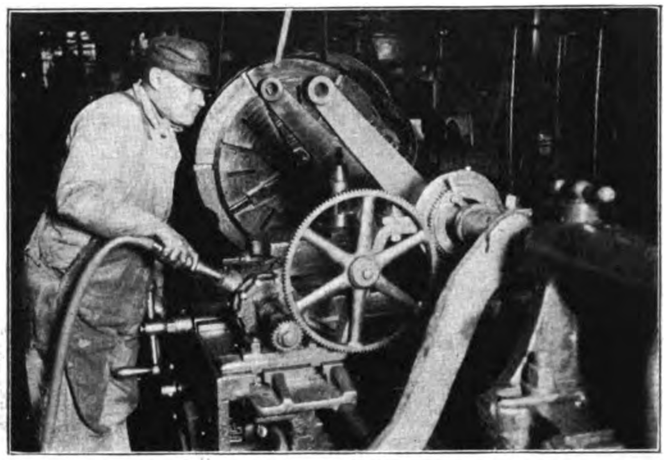


Fig. 10—Lathe attachment for turning a reverse shaft journal

end of the reverse shaft. It is then lined up in the two part housing in which it revolves. The hexagon spindle of the pinion gear is driven by a correspondingly shaped socket with a Morse taper shank, which fits into any

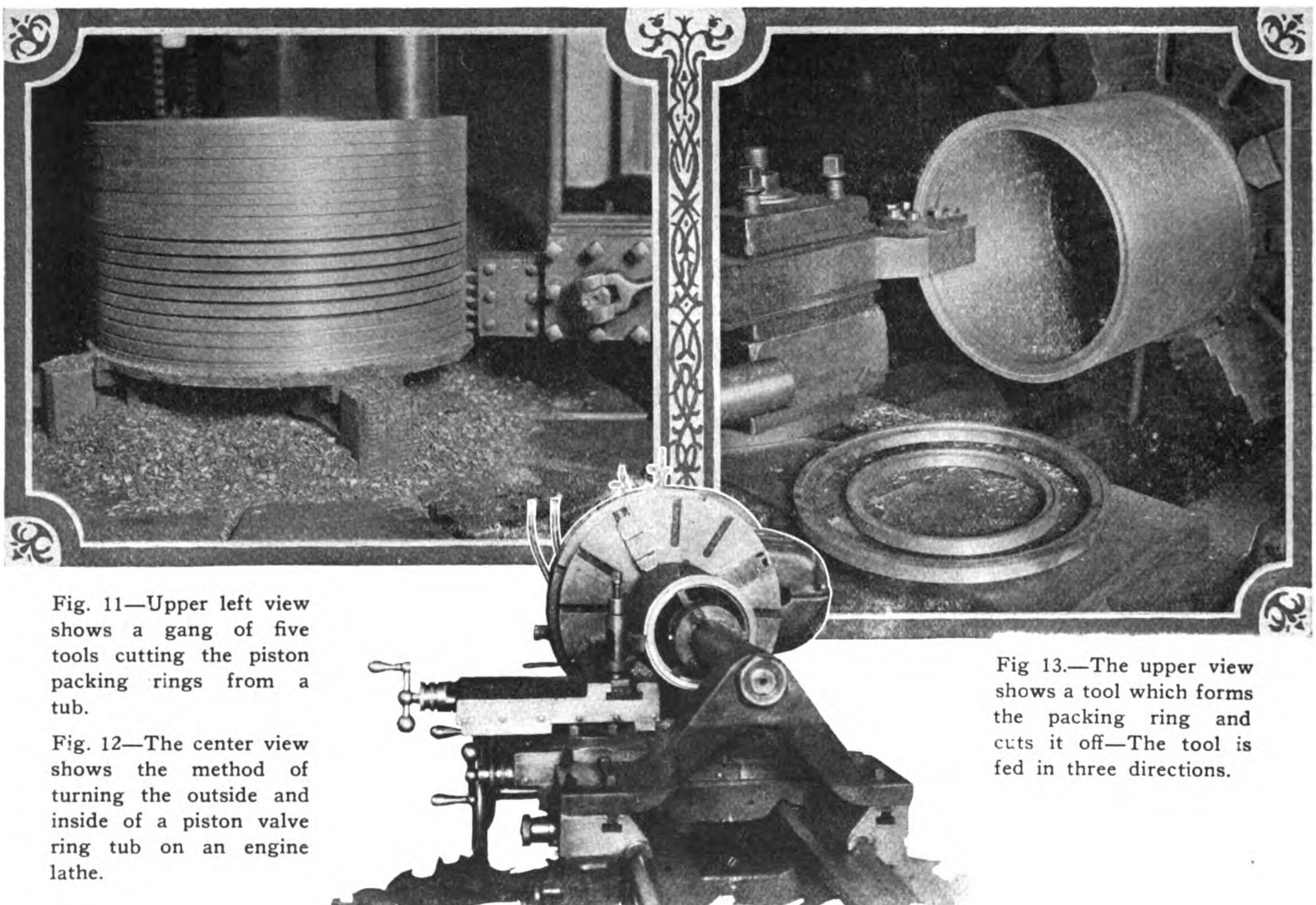


Fig. 11—Upper left view shows a gang of five tools cutting the piston packing rings from a tub.

Fig. 12—The center view shows the method of turning the outside and inside of a piston valve ring tub on an engine lathe.

Fig 13.—The upper view shows a tool which forms the packing ring and cuts it off—The tool is fed in three directions.

A reverse shaft is one of the most awkward locomotive parts to be set up on any machine. With the special attachment shown in Fig. 9, this part can be handled on

standard air motor. When making a cut the lathe is started, the center in the head stock revolving idly in the center of the reverse shaft. The tool is then driven

through the gear train by an air motor and is fed across the work by the lathe carriage.

Machine cutting tools

The machining on a side head boring mill of piston packing rings from a casting offers a splendid oppor-

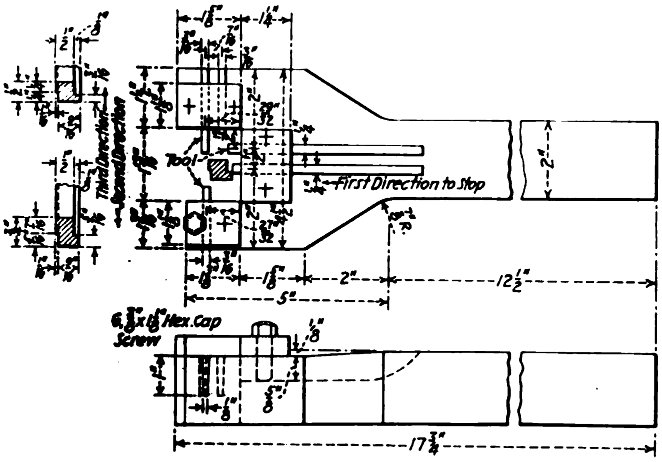


Fig. 14—Detail of lathe tool for forming piston valve packing rings

tunity to save time by boring the casting inside and out at one operation and by using a gang of tools for cutting the rings. The method of machining tub castings on a vertical boring mill at the Houston shops is shown in Fig. 11. The casting is finished turned on the outside and rough bored on the inside at the same time. Then a set of five tools is started to cutting off the rings. The rings are not entirely separated from the casting, however, as the tools cut through only as far as the stock that is left for the finish boring cut. The gang tool is withdrawn and the boring tool is started on the finish cut

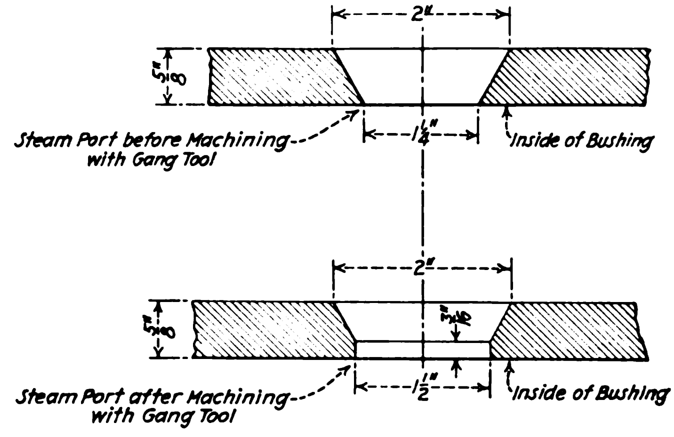
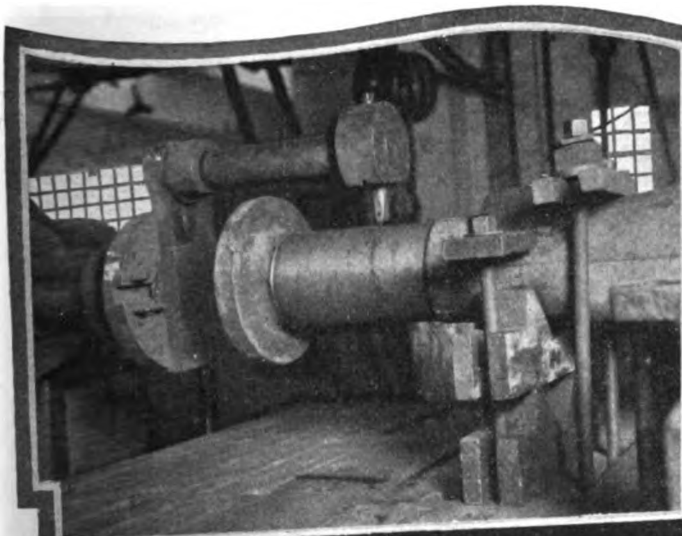
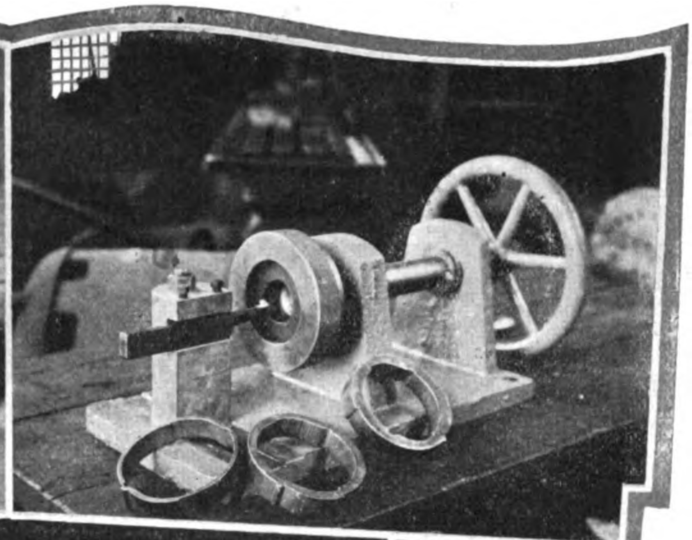


Fig. 18—The dimensions to which the port is machined on a boring mill with a gang tool

which separates the rings from the casting. This method not only saves time, but also eliminates the crumbling of the inside edge of the rings which occurs when the cutting-off tools are allowed to cut all the way through.





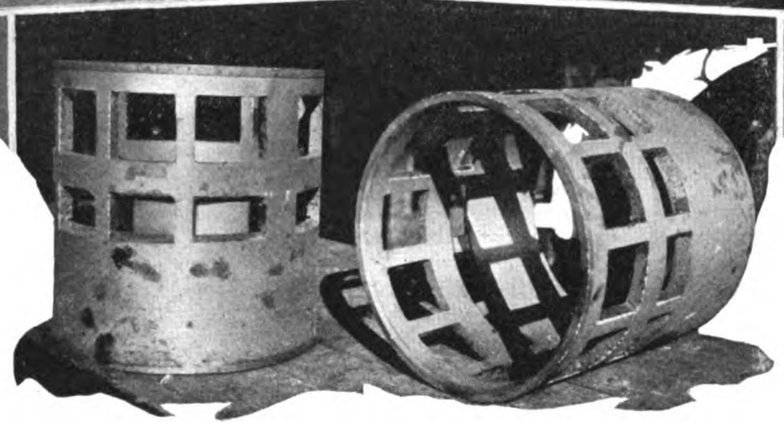


Fig. 15—The upper left view shows a method of machining a steam pipe fit on a horizontal boring, drilling and milling machine.

Fig. 16—The upper right view shows a hand operated portable machine for boring out piston rod packing

Fig. 17—The lower view shows two valve bushings the posts of which have been designed to eliminate milling and hand filing

Figs. 12 and 13 show the method and tool used for turning out piston valve rings by chucking the casting in a lathe. The casting tub is first finished inside and

out at one operation. The inside of the casting is bored out by a special tool which carries three cutters on its circumference. The shank of this tool is supported in a hardened steel bushing which takes care of the lathe spindle. After the casting is bored to size, the rings are shaped and cut-off by a special tool, a drawing of which is shown in Fig. 14. Three cutters and two stops are required in this tool to form the ring. The tool is fed successively in three different directions as indicated by the arrows on the drawing. No cut is taken in the first direction, which serves to bring it into position for the succeeding operations. This tool saves considerable time when using a lathe as the rings are completely finished in one set-up.

The machining of a steam pipe is another job which is difficult to handle owing to its irregular shape. Fig. 15 shows the machining of a steam pipe where it passes through the smoke box gland. The pipe is mounted on a horizontal boring mill. The tool is attached to the revolving head of the machine by a flange collar keyed to the spindle. The design of the tool allows it to clear

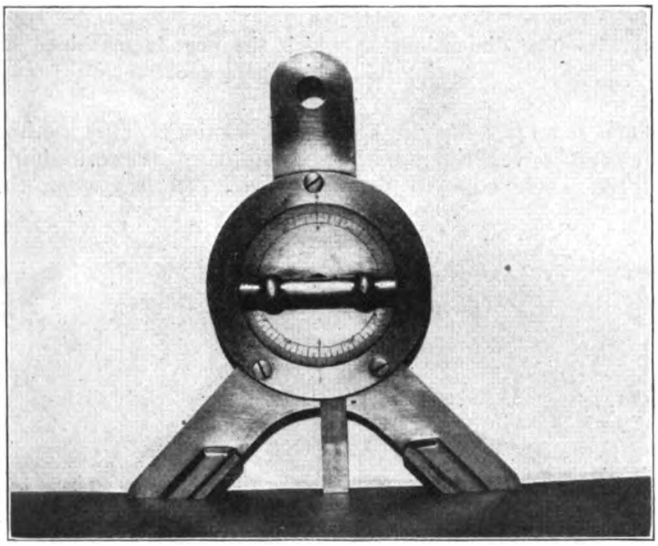


Fig. 19—Gage used for locating eccentric keyways on new axles for Stevenson valve gear

the flange of the steam pipe and it is fed across the work by the spindle feed.

Miscellaneous devices

The renewal of piston rod packing is one of the frequent jobs at an engine terminal. The packing has to be bored out to the size of the piston rod. As the packing is of soft metal it requires no great amount of power to do this work if the proper tool is available. Fig. 16 shows a hand operated machine for boring out Paxton Mitchell packing. To prevent the packing from turning while boring, the chuck is so designed that the outside of the largest size packing fits securely in a socket of the same shape. The knurled hand chuck is then screwed up against the face of the packing. The cutting tool is adjusted for the diameter to be cut after which the packing is fed to the tool by means of a hand wheel the spindle of which operates in two threaded bushings.

For the next smaller size of packing, the ring shown at the left in Fig. 16 is inserted in the chuck. This is merely a reducer. In like manner, the other two rings shown are used for smaller packing sizes. This machine is easy to make and operate and is readily portable.

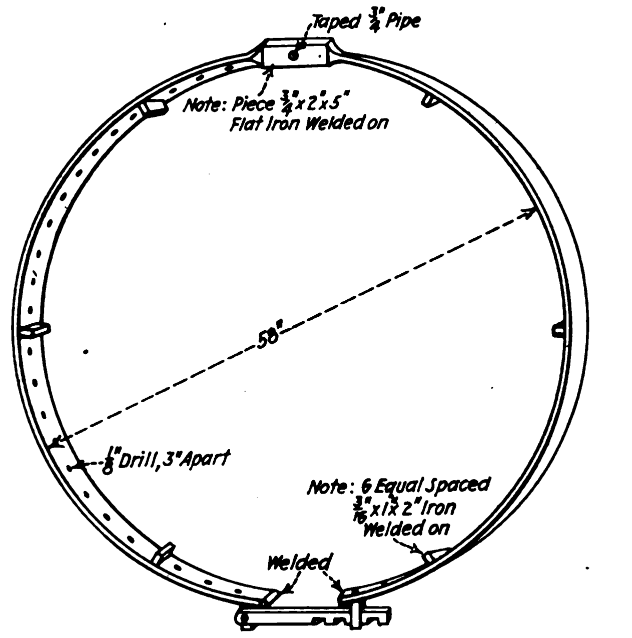
Fig. 17 shows a valve bushing, the ports of which have been designed to eliminate milling machine work and hand filing. This is accomplished by casting 30-deg. bevels on the outside of the circumferential sides of the port opening. The proper width and sharpness of the edge of the steam port is obtained by using a gang of tools, with the outside edges of the cutter ground to the width of the steamports, and cutting about 3/16 in. deep, as shown in Fig. 18, from the outside of the bushing. This work can be completed on a vertical boring mill.

The gage shown in Fig. 19 is used for locating eccentric keyways on new axles for locomotives equipped with the Stephenson valve gear. It is used in the following manner. The line is scribed on the axle through the wheel fit keyway and extends to the eccentric fit. The face plate of the lathe is quartered, which allows the axle to be revolved 90 deg. Another line is then scribed. A reference chart has been worked up which shows the relative position of the eccentrics with respect to the center line of motion for all classes of locomotives. The proper center line is selected from the chart and then the protractor is set so that the perpendicular scale coincides with this line. The spirit level is then adjusted to an exact level. The reading is then observed on the gage and the required number of degrees is added for the particular class of locomotive on which the work is being done, after which a line is scribed for the center line of the forward motion eccentric. The same method is followed for the back-up eccentric keyway.

Tire heater made from a boiler tube

By J. F. Bradley

A TIRE heater made from a used locomotive boiler tube is shown in the sketch. The tube has been flattened to a 3/8-in. opening in the center and has been drilled on the inside with 1/8-in. holes, three inches apart.

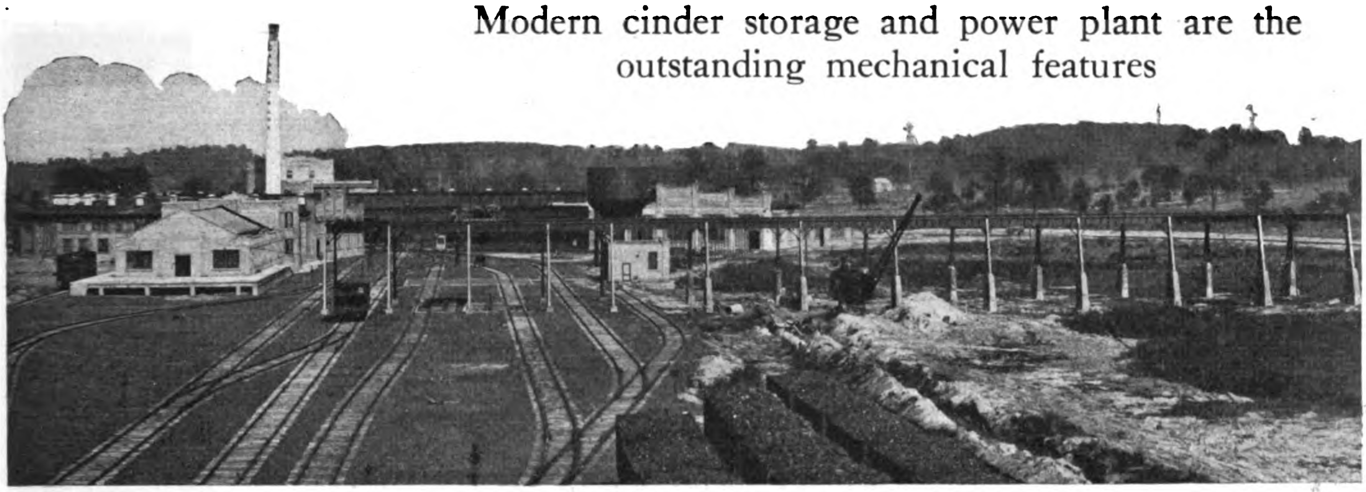


Sketch of tire heater made from a used boiler tube flattened to 3/8-in. opening

The ends are welded at the bottom and provision is made for adjustment to tires of different diameters. Fuel oil is forced through a 3/4-in. pipe to the top of the heater as shown in the sketch.

Grand Trunk Western completes modern terminal

Modern cinder storage and power plant are the outstanding mechanical features

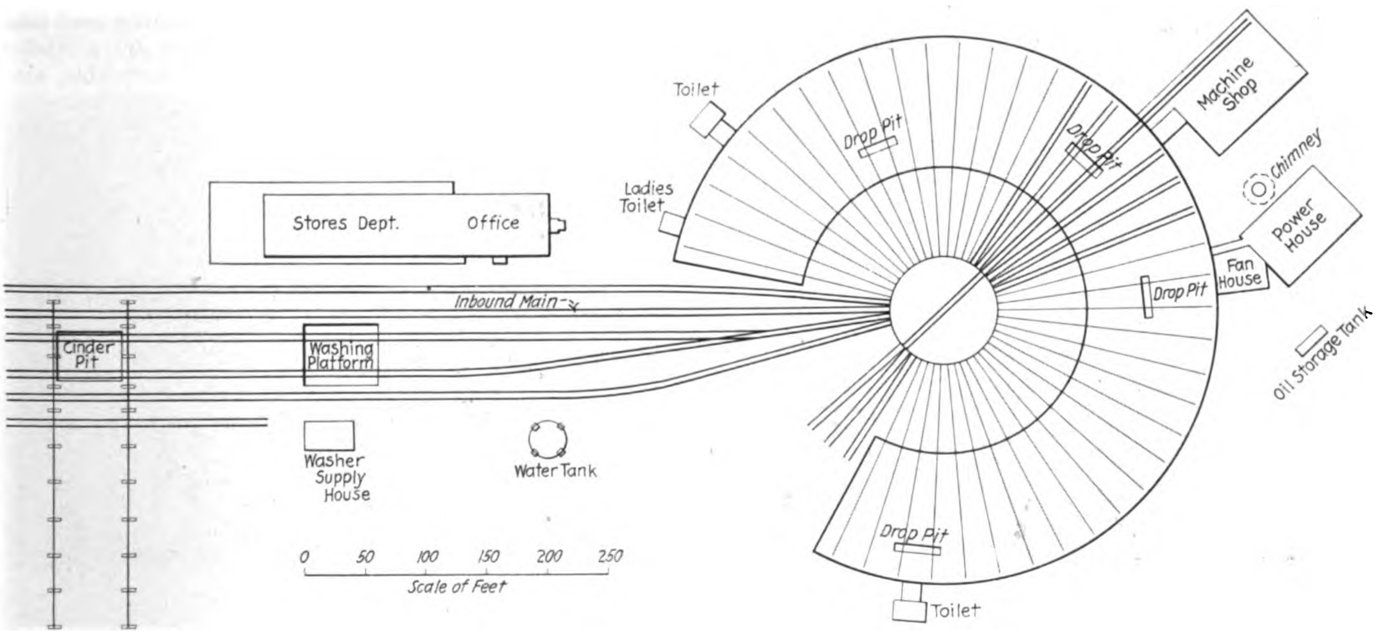


General view of new Grand Trunk Western engine terminal at Battle Creek, Mich.

THE Grand Trunk Western recently placed a new engine terminal in operation at Battle Creek, Mich., which is a notable example of a terminal designed for maximum operating convenience with a minimum of labor. The outstanding feature of lay-out—one which constitutes a radical departure from established practice—is the method of handling cinders. Realizing the great loss at times incurred by the necessity of holding cinders in cars until used by the maintenance-of-way department, an intensive study was made by the railroad company's engineers over a period of several years with the idea of eliminating this condition.

One of the illustrations clearly indicates the general arrangement of the ash pit and cinder storage facilities. The ash pit, a somewhat unusual variation of the water-type pit, is capable of handling an average of 100 locomotives in a 24-hour period without congestion. This is due, to some extent, to the fact that the ash pit capacity has been purposely limited so that it must be entirely utilized for fire cleaning rather than for storage. In other words, locomotives must be handled over the pits as fast as they arrive.

The design of the pit was worked out to provide maximum safety—it may readily be seen that the danger of men falling into the pit has been almost entirely eliminated. The cinders are removed from the pit with a clamshell bucket and a traveling crane operating on a runway at right angles to the ash-pit tracks. The length of the runway is approximately 350 feet and the span of the crane, 60 feet. It has been found possible, under present operating conditions, to handle all of the 24-hour accumulation of cinders with this crane in about three hours.



Track layout of the Grand Trunk Western engine terminal

The estimated ground storage capacity of this cinder handling plant is a seven months' accumulation, based on the despatching of 100 locomotives each 24 hours.

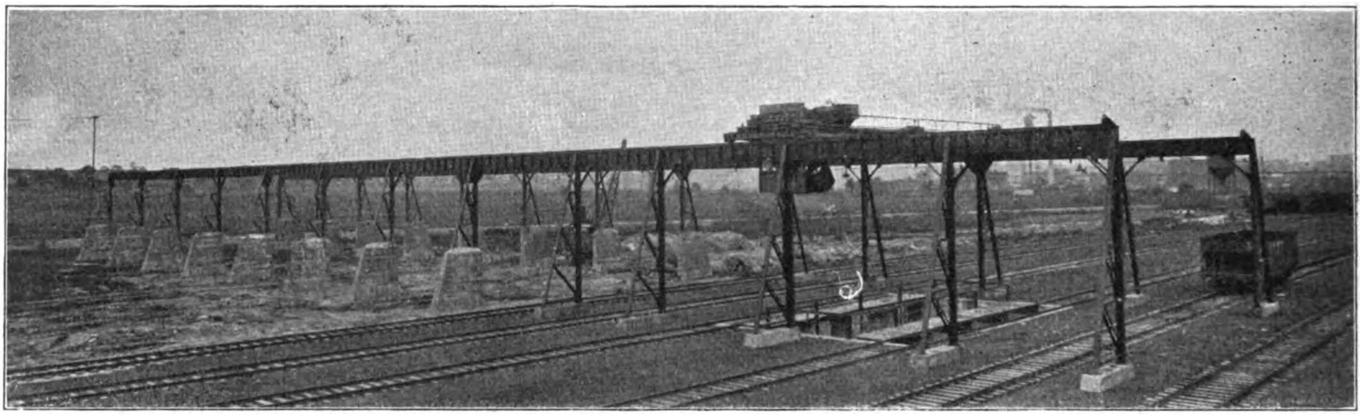
Another feature of particular interest from an operating standpoint is the track layout. One of the drawings shows that the tracks and switches have been arranged in such a manner that the blocking of the terminal is almost an impossibility.

Outside facilities

Approaching the terminal, locomotives first may be coaled at an automatic electric coaling station of 500 tons capacity provided with two coal chutes on each of three tracks. An average of 252 tons of coal is issued to locomotives each 24 hours while at times this approaches a maximum of 500 tons in the same period. Sand is also provided at the coaling station. The sand storage capacity is 350 tons. The hoppers and elevators for sand are the same as for coal handling. The coaling station is located about 1,500 feet from the turntable. One detail of the coaling station that is of interest from a mechanical standpoint is the installation of an independent electric-driven air compressor which eliminates the necessity of piping air over a distance of practically 2,000 feet from the terminal power plant.

Passing from the coal dock, locomotives may approach the turntable by means of five different tracks, two of which pass over the ash pit and engine washing platform, and converge onto a single track leading to the turntable. Each of the other three tracks provides access to the turntable. The locomotives are washed by means of the Durham & McGuirk engine washing system, using an emulsion of oil and water under steam pressure. Adjacent to the washing platform a well appointed wash house and locker room has been provided for the fire cleaners and engine washers.

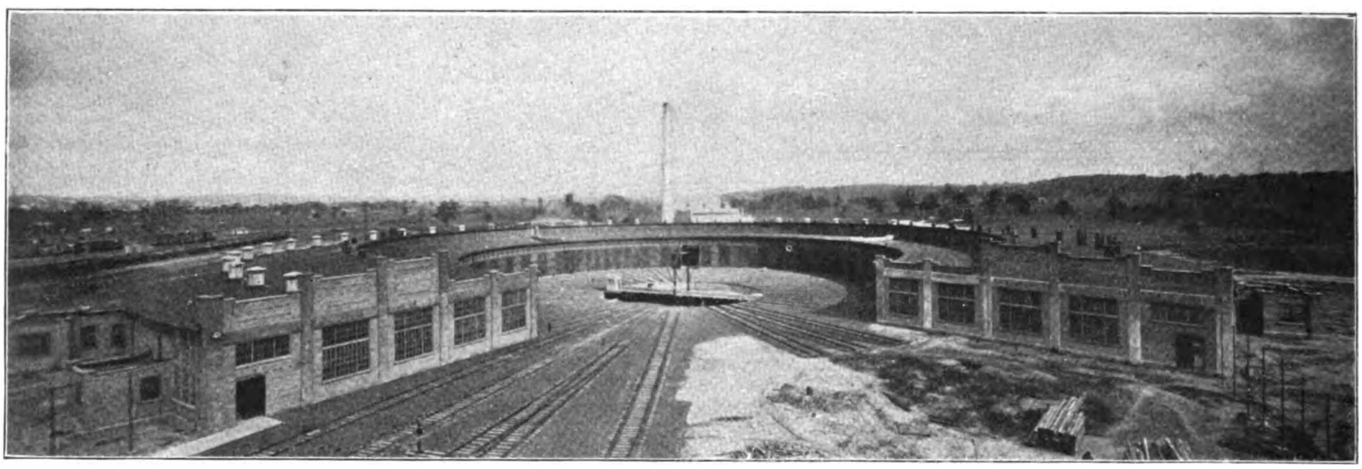
Opposite this point is located the storehouse and office building, in the basement of which the oil and tool supply room is located. In addition to stores department offices the office building has space for the individual offices of the general enginehouse foreman, chief engine despatcher, and road foremen of engines, and an assembly and a first-aid room—all on the first floor. The second floor has locker rooms and shower baths for road crews. A unique feature of office arrangement has been carried out in the general enginehouse foreman's office. The location of his desk in a bay is such that he commands an unobstructed view of the entire terminal yard.



Cinders, which are stored until needed, are handled by this crane

The engine house

The engine house is a 40-stall timber frame and brick house built on a 52-stall circle and served by a 90-foot Bethlehem through-girder type, balanced turntable, electrically driven. The depth of the house is approximately 110 feet.

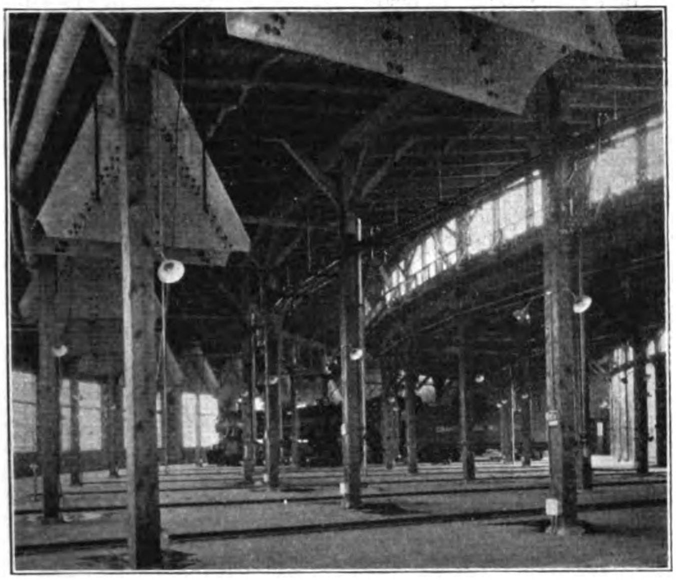


The enginehouse is a 40-stall house. The power plant is visible in the background

Stalls Nos. 8 and 9 are served by drop pit jacks to accommodate tender wheels; stalls Nos. 17 and 18 with jacks to handle trailer wheels; stalls Nos. 23 and 24 with jacks to handle driving wheels; and stalls Nos. 37 and 38 with jacks for dropping engine truck wheels. Watson-Stillman hydro-pneumatic jacks are used. No overhead crane facilities have been provided other than chain hoists at temporary locations for the handling of heavy materials. Practically all materials of this nature, either

in process of being transported about the shops and engine house or in process of repair work, are handled by means of a 3,000-lb. capacity Baker R. & L. portable electric crane.

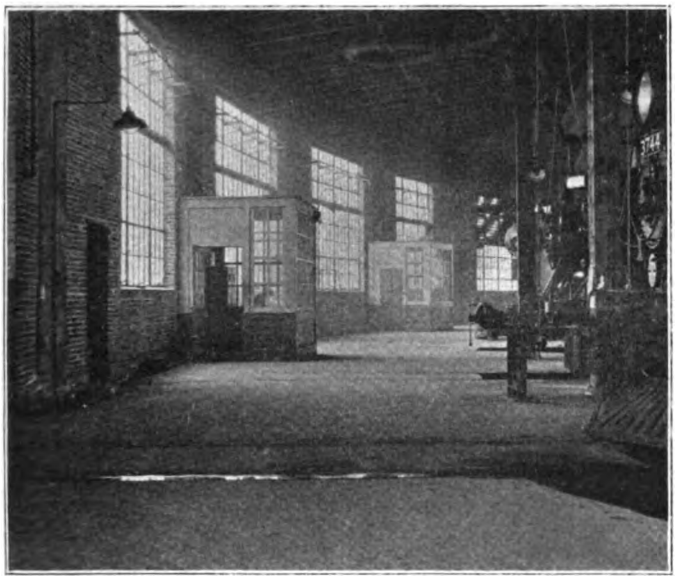
All of the 40 stalls of the engine house are piped for the Miller boiler washing and filling system, while 15 of the stalls are, in addition, arranged for a direct steam-



Interior view of the enginehouse

ing system designed by the Locomotive Terminal Improvement Company. All stalls are piped for steam blower lines and with oil for the oil firing system. Leadized pipe, furnished by the National Boiler Washing Company, Chicago, was used for hot and cold water lines throughout the enginehouse and powerplant.

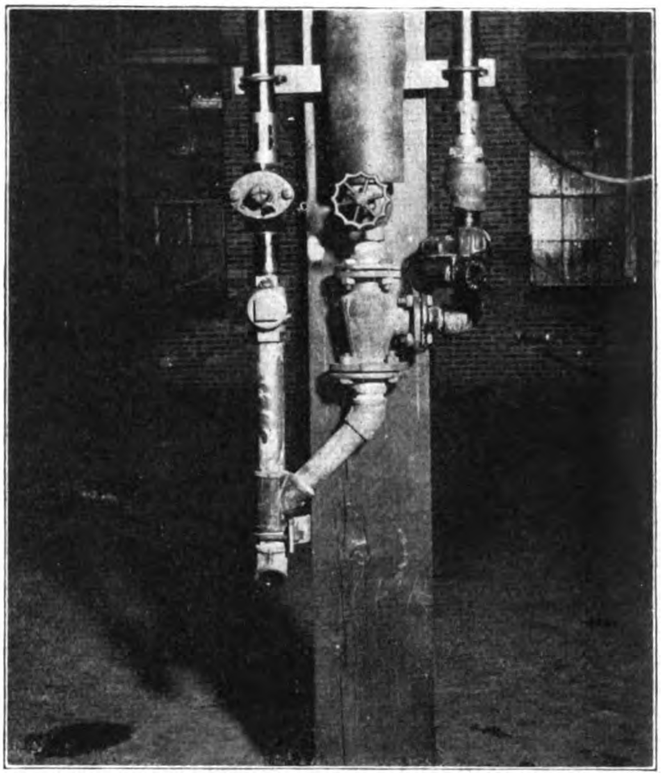
As previously mentioned, the engine house is completely



Offices for enginehouse and boiler foremen are located in the circle and are visible for a long distance

equipped with an oil firing system. The fuel oil supply is stored in a 10,000-gal. tank, located outside, and filled by air pressure direct from tank cars. The oil is fed by gravity to a centrifugal pump which circulates it through the pipe lines to all stalls and returns it to the tank. A steam coil is provided in the main storage tank to aid the oil circulation in cold weather. At each stall there is an oil and air line drop together with 15 feet of special flexible oil hose equipped with a special firing nozzle, or torch. In the firing of locomotives, from four to six inches of green coal is spread on the grates, which is lighted by the oil torch through the fire door. Whereas in some engine houses, fires are started by spreading oil over the entire coal bed and igniting it, with this method an area on the grates of only about one or two square feet is first ignited with the firing torch and the house blower used to complete the firing process.

One of the illustrations shows the arrangement of the outlet piping at one of the stalls arranged with the combination of boiler washing, filling and direct steaming drops. By means of the direct steaming system, after the boilers have been washed out, they are filled with water at a temperature of about 180 deg. F. then, live steam is



One of the drops arranged for direct steaming or booster system

turned into the boiler at a pressure of approximately 150 lb. per sq. in.

The machine shop

The machine shop is connected to the engine house opposite stalls Nos. 18 to 20 inclusive. The track at stall No. 18 is a through track, running from the turntable over the trailer drop pit and through into the machine shop. The tool layout is shown in one of the drawings. Following is a list of the machine tools in this shop, all of which were purchased new:

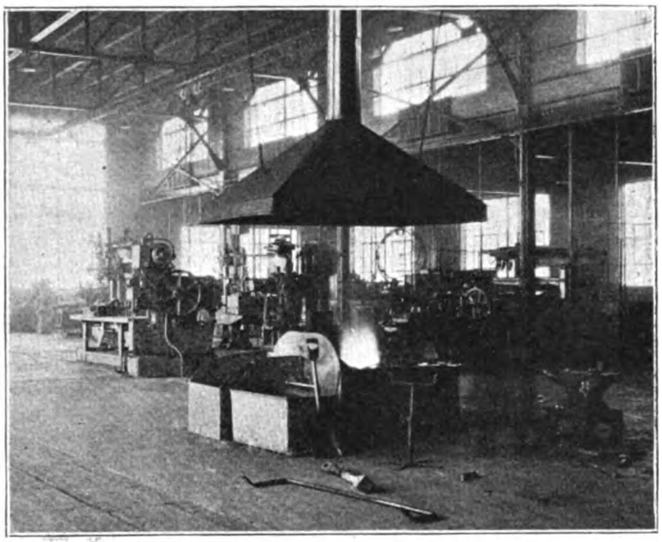
1 21 in. engine lathe
1 14-in. by 8-ft. American tool room lathe
1 No. 45 Buffalo punch and shear
1 Oster pipe machine
1 Bardons & Oliver 15-in. by 8-ft. brass lathe
1 1,500 lb. Nazel pneumatic hammer
5 5-hp. Ranson double end grinders (four of which are located in the engine house)
1 American 3-ft. radial drill
1 Tinners' folding machine
1 Stove pipe former
1 42-in. Bullard vertical turret lathe
1 Acme 3-in. single-head bolt cutter
1 50-ton hydraulic bushing press
1 Buffalo blower forge

Substantially constructed work benches equipped with swivel base vises are located at alternate stalls throughout the house. The photograph of the machine shop shows the monorail overhead traveler which serves all of the machines in the machine shop, as well as the through track from the engine house.

The power plant

Probably one of the most interesting things from a purely mechanical standpoint is the power plant, which is located opposite stalls Nos. 22 to 24 inclusive. In designing this plant every effort was made to install mechanical equipment of such nature as would permit its operation with a minimum number of men. As a matter of fact, the total power plant operating force at the present time, consists of three men, one on each eight-hour shift.

Steam is generated by two 250-hp. Connelly water tube boilers designed to operate at a working pressure of 150 lb. per sq. in.; Elesco super-heaters raise the temperature of the steam to a super-heat of approximately 100 deg. F. Natural draft only is used, this being provided by means of a concrete stack 150 ft. high and five feet in diameter at the top. The boilers are fired by Laclede



General view of the machine shop—An overhead monorail traveler serves all machines

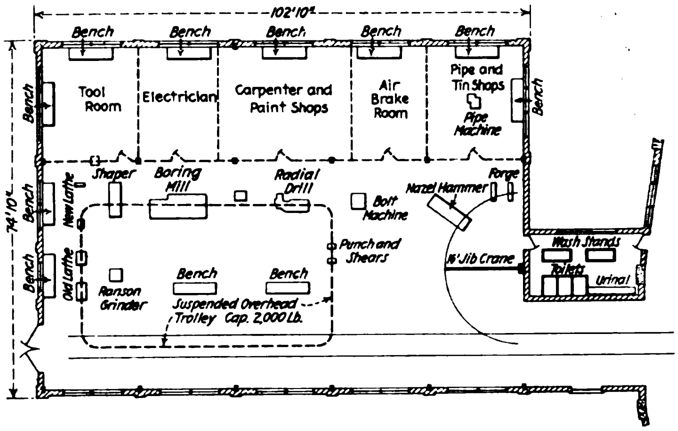
chain grate stokers and the coal and ash handling systems are of Brownhoist manufacture. The coal is dumped into a hopper outside the plant, run through a crusher into a conveyor and is elevated to steel overhead bunkers having a capacity of 150 tons. From the overhead bunkers the coal is conveyed by gravity to a traveling weigh lorry, which weighs each unit quantity of coal delivered to the boilers. The ashes are discharged at the rear ends of the stokers into a pit underneath the boilers. From this pit they are raked into the same conveyor which handles the coal and conveyed to an outside ash hopper having a storage capacity of approximately 50 tons. From this hopper they are dumped by gravity into cars.

The mechanical equipment of the plant consists of two air compressors, one of which is electrically driven, boiler feed pumps and wash out tanks and pumps for the boiler washing and filling system. A full complement of recording instruments has been installed.

During the construction of this terminal, considerable difficulty was encountered in overcoming the effects of natural-flowing wells and surface drainage water. One of these natural wells is located directly under the power plant. It was necessary to go to a great deal of trouble in the construction of the power plant foundations to seal the walls against seepage, and in addition a centrifugal pump has been installed. Fortunately, the purity of this water makes it of exceptional value for boiler feed purposes and it is planned to thus utilize it.

Heating and lighting

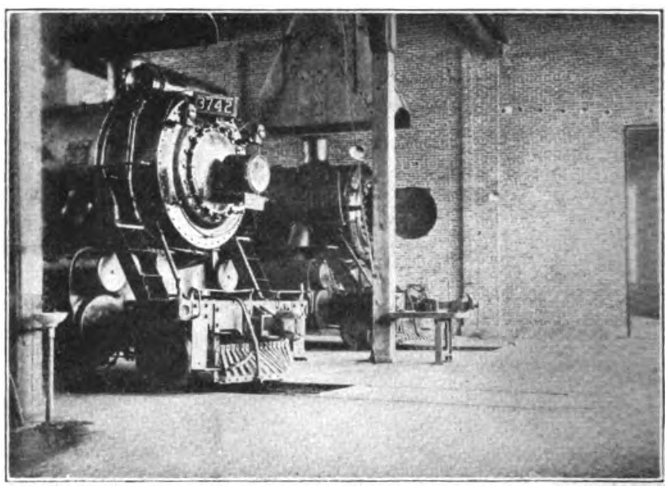
The engine house is heated by an indirect steam system. The air is heated by means of steam coils and circulated to each pit in the engine house by means of fans and con-



Arrangement of facilities in the machine shop

crete ducts. The total steam requirements of the heating system is approximately 400 b. hp. at an outside temperature of zero deg. F. Two 40-hp. fan engines driving Clarage fans furnish, under ordinary weather conditions, sufficient exhaust steam to supply the heating requirements of the engine house.

Each stall is artificially lighted by eight 75-watt lamps mounted on the columns with additional lamps located on the inside and outside circle walls. Switches are placed at



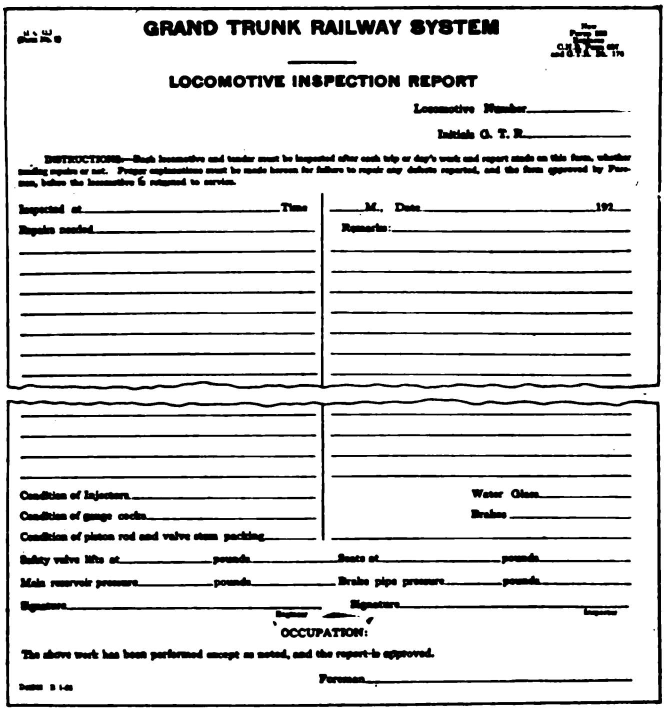
Work reports are posted at each stall and are removed only after all work has been completed

each end of each pit so that it is never necessary to walk more than half the length of a stall to turn lights on or off. Four receptacles are provided at each pit for portable extension lights.

Operating conditions

The new Battle Creek terminal, under present operating conditions despatches an average of 1,118 locomotives per month or 37 each 24 hours. About 93 per cent of the total power despatched is freight and switching

power. In general locomotives are assigned to regular crews. From this terminal power is despatched to Port Huron, Mich., on the east and to Chicago on the west. On the eastbound runs both freight and passenger locomotives operate over a district of 157 miles while on the westbound runs the freight locomotive district mileage is


GRAND TRUNK RAILWAY SYSTEM

LOCOMOTIVE INSPECTION REPORT

Locomotive Number

Initials G. T. R.

INSTRUCTIONS—Each locomotive and tender must be inspected after each trip or day's work and report made on this form, whether needing repairs or not. Proper explanations must be made hereon for failure to repair any defects reported, and the form approved by Foreman, before the locomotive is returned to service.

Inspected at ______ Time ______ M., Date ______ 192__

Repairs needed ______ Remarks: ______

Condition of Injectors ______ Water Glass ______

Condition of gauge cocks ______ Brakes ______

Condition of piston rod and valve stem packing ______

Safety valve lifts at ______ pounds ______ Seats at ______ pounds

Main reservoir pressure ______ pounds ______ Brake pipe pressure ______ pounds

Signature ______ Engineer Signature ______ Inspector

OCCUPATION:

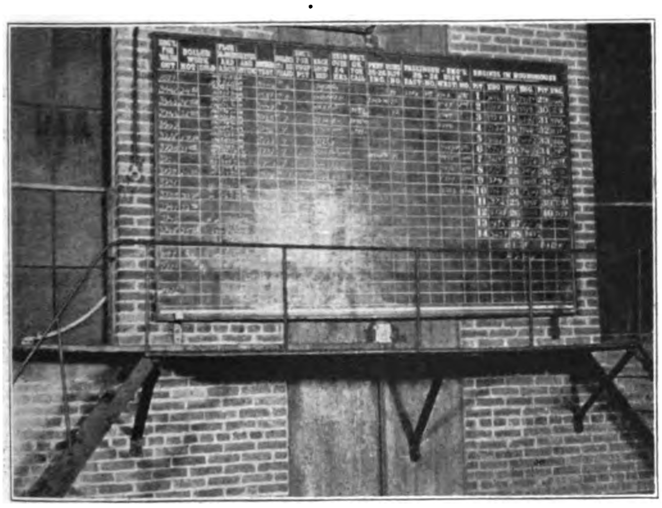
The above work has been performed except as noted, and the report is approved.

Foreman ______

Locomotive inspection report which is posted alongside the locomotive in the enginehouse

169, and the passenger 185. The period of peak demands for power occurs between the hours of 11:00 p.m. and 6:00 a.m. which peak is occasioned by the arrival and departure of eastbound manifest freight trains from Chicago.

A system of handling work reports in the engine house



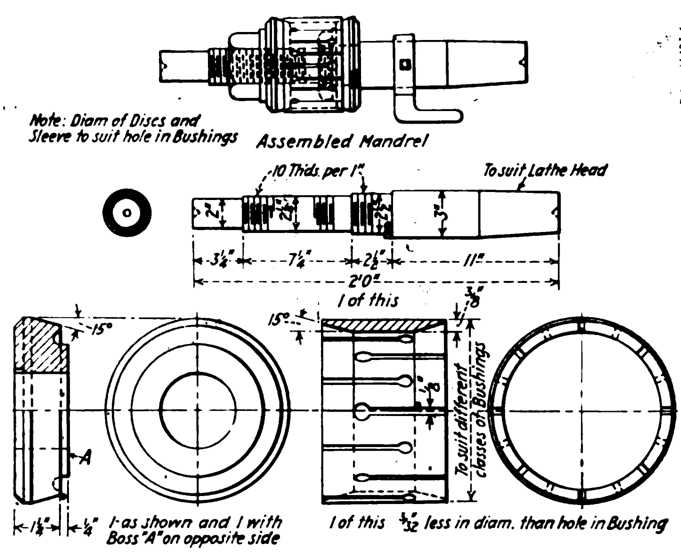
Board showing status of work and locomotives assigned

is in effect which seems to be a decided improvement over the methods employed at a great many terminals. The engineman's and inspector's work reports are combined on the right side of a single printed form. This completed work report form is posted in a metal frame at the stall in the engine house in which the locomotive is placed. As the individual items of repair work on that locomotive are completed the man having done the work enters his remarks and signature on the left side of the form. The foreman is thus able to ascertain at a glance the progress of the work on any particular locomotive. When he is satisfied that all work has been properly performed he attaches his own signature to the report and removes it to be filed away. The removal of the report indicates that the locomotive is ready for service. This scheme of handling reports saves a great amount of time. It is not necessary to go to the central work board to learn whether or not a locomotive is ready. The hostlers may check the assignment board and the presence or absence of the work report at the stall where the locomotive is located indicates whether or not it is ready to be taken out of the engine house.

Mandrel for turning rod bushings

By E. A. Miller

THERE are a number of railroad shops throughout the country that make it a practice to chuck rod bushings on a lathe for turning. This method requires reversing the bushing in order to finish the end which was held in the jaws of the chuck. The mandrel shown in the drawing, has been designed with the principal object of enabling the lathe hand to machine the bushing in one operation. Referring to the drawing, the mandrel consists essentially of a shaft turned and threaded as shown, an expander and two expander cones. The expander is placed inside the rod bushing. One of the

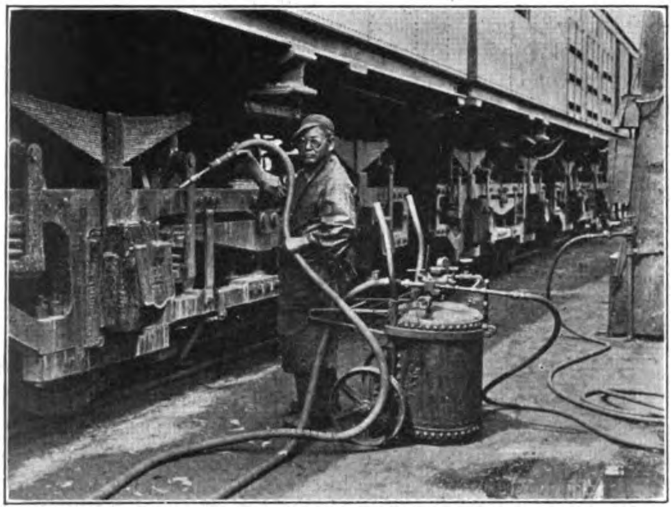


A convenient device for turning rod bushings on a lathe

expander cones is made to fit the 2½-in. seat on the shaft, where it is held in place by a 2½-in. half-nut and is prevented for turning by a key on the shaft. The shaft is then inserted through the expander, the second expander cone is placed on the shaft and the two expander cones are drawn together by means of a 2¼-in. nut. The expander is turned to 3/32-in. less diameter than the inside of the bushing and is slotted as shown in the drawing. As the expander cones are forced into the expander, the slots become wider, thus increasing the diameter of the expander. It only requires a few turns of the 2¼-in. nut to get a tight grip on the inside of the rod bushing and it is then ready to be placed in the lathe.

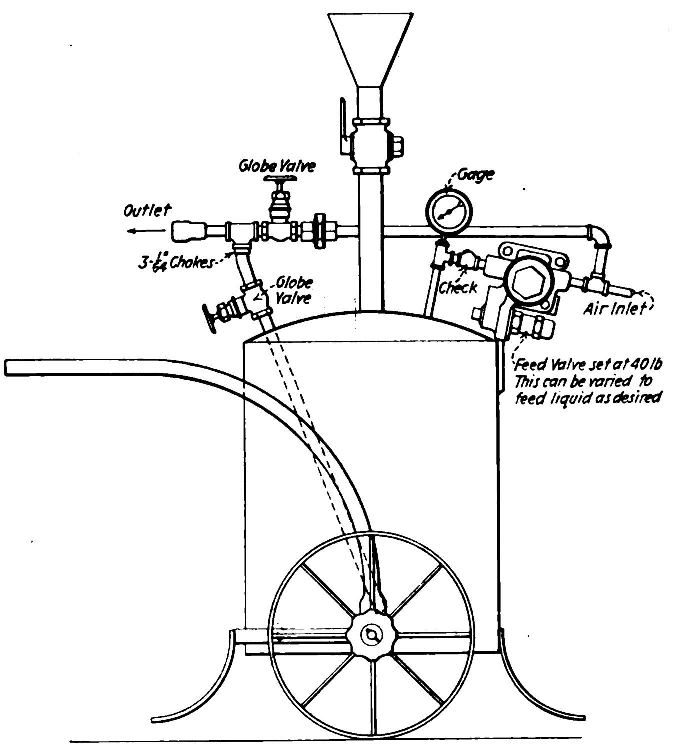
Frame washer for electric locomotives

A SPECIAL type of frame washer designed for use on the frames of electric locomotives has been developed in the Chicago, Milwaukee & St. Paul shops at Deer Lodge, Mont. The washing machine usually used with steam locomotives is not satisfactory for certain types of electric equipment on which the motors hang in such a position that water might enter and injure them.



The washer in service

The machine consists essentially of a drum fitted with pipe connections, a reducing valve, a gage, two globe valves, a filling cock and necessary hose connections, all mounted on a two-wheel truck. Air pressure forces the washing liquid upward through the pipe which extends to the bottom of the drum, through the globe valve and through a choke consisting of three 1/64-in. holes. It has been found that orifices of this size control the flow of the liquid sufficiently without other regulation. On a similar machine built previously, a feed valve was used, which is now done away with. The purpose of the feed valve was to carry various air pressures to further regulate the flow of the liquid but it has been found that with the three 1/64-in. holes, the pressure on top of the liquid provides about the right amount of spray.



Side elevation of the washer, showing form of construction

The machine is operated as follows: The valve is closed on top of the tank and the valve on the air pipe is opened, allowing the shop air to flow through a convenient length of hose being used at the point marked "Outlet." The air passes through the outlet and through the hose and finally out of a nozzle which is made of a short piece of pipe flattened at one end, the nozzle has an opening which is 1¼-in. long by 3/64-in. wide. The air blast is first used to blow the dust from the frame after which the valve at the top of the tank is opened and the air pressure on top of the liquid causes the liquid to flow up to the tee just ahead of the air regulating valve where it becomes mixed with the air which is blown on the frame. This cuts the dirt sufficiently so that after one section of the frame has been treated with the solution the liquid is again shut off and the liquid and accumulated dirt blown free from the frame. With this arrangement no waste is used and the only other cleaning necessary is at points where free oil may have collected. The free oil is taken off with a little kerosene put on with a paint brush.

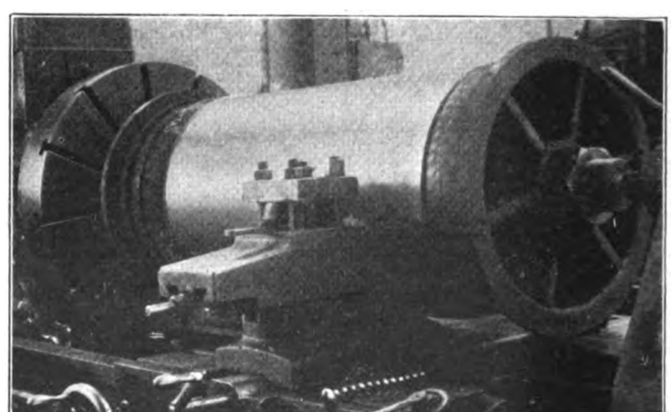
By this method, one man can clean both sides of the frame of an electric freight locomotive in two hours time. Before the washer was used it took five laborers the same length of time, the laborers using about 20 lb. of cotton waste and two gallons of kerosene for the job. The solution used in the washer consists of one pint of kerosene or mineral seal oil and 1 lb. of soap to each gallon of water. This mixture is boiled thoroughly before being put in the washer and the solution when made up costs about three cents a gallon.

A good way to machine cylinder bushings

By G. N. Cagle

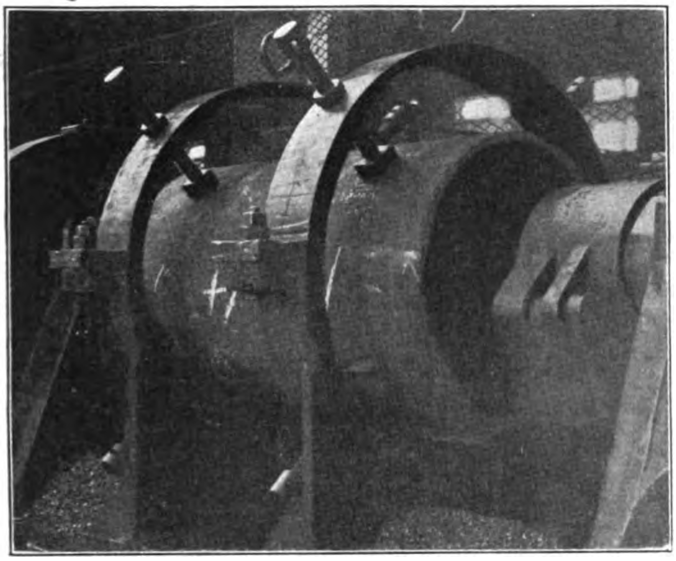
General machine shop foreman, Central of Georgia, Macon, Ga.

A SPECIAL jig for boring and facing cylinder bushings on a Newton horizontal boring machine has been developed in these shops. The bushing is first placed on a drill press and a hole is drilled in one end for a dog



Turning the outside surface of a cylinder bushing on a 36-in. lathe

to hold it while being bored and turned. The bushing is then placed in a special jig on the horizontal boring machine which is shown in one of the illustrations, for boring and facing. This jig consists of two cast iron sections for the base and two wrought iron top straps, provided with two screws for purposes of adjustment. A small steel block is attached to the ends of the adjusting screws to provide a bearing surface against the outside of the bushing. The time from floor to floor in setting up



Jig for holding a cylinder bushing on a horizontal boring machine while boring and facing

the bushing on the horizontal boring machine ready to bore when using this jig is ten minutes. At this set up, the bushing is bored, both ends counterbored and one end is faced off to leave the counterbore of the correct length. The time required for this operation is 7 hr. 15 min.

The bushing is next removed to a 36-in. lathe and is placed in a special jig for turning the outside surface. This jig consists of a shaft and two cast iron heads which are turned as shown in the drawing, to suit different size bushings. This jig as well as the one used for boring, is of rigid design and will stand heavy cuts and feeds.

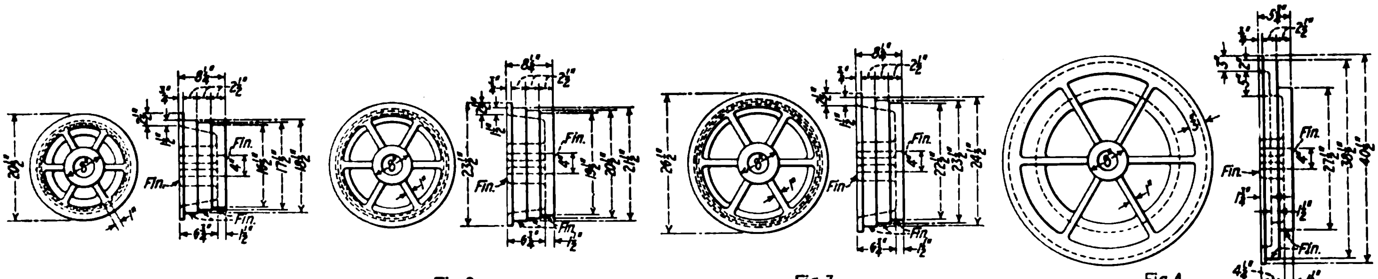


Fig. 1 Fig. 2 Fig. 3 Fig. 4

Drawing showing four sizes of mandrels used for turning cylinder bushings on the outside

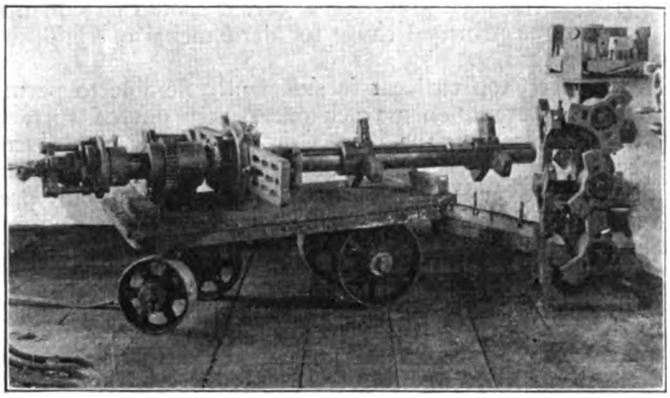
Referring to the drawing, the jigs or mandrels used in turning the bushings are made of cast iron. The sizes range from 20½ in. outside diameter as shown in Fig. 1, which is the smallest, to 40½ in. as shown in Fig. 4. Figs. 2 and 3 are 23½ in. and 26½ in. outside diameter, respectively. The time required for this operation from floor to floor is 5½ hours.

We have found this rigging to be a valuable addition to our shop equipment because it performs the work much faster and also gives a more perfect cylinder when compared to the old method of finishing on a vertical boring mill. Our experience has shown that doing this work on an engine lathe with blocks and bar or using an engine lathe with spider heads and adjusting screws will result in an imperfect job.

Jig for truing the cutting tools in a valve bushing boring head

MANY railroads are standardizing the methods of repairing valve motion parts. For example, piston valve bushings are bored out in steps of ⅛-in. instead of just truing up the worn bushing. Thus, if a 12-in. bushing is worn it is bored to 12⅛-in. This work is simplified further by keeping in the tool room boring heads with the tools set to bore the required diameter. Thus, if a bushing is to be bored to 12⅛-in., a pair of No. 1 cutter heads are asked for. Two heads are required as the two parts of the bushing are bored at the same time.

As shown in the illustration, these cutting heads are



Valve bushing boring head stand with a jig on top for setting the boring tools used in the heads

held on a stand, at the top of which is located a jig for properly adjusting the cutter tools to the correct diameter. The cutter head fits snugly over a pivot pin located in the center of the jig. The three hardened steel plugs used for setting the cutting tools are numbered consecutively 1, 2 and 3 and are held in position by a knurled nut. These setting plugs are lined up by a small keyway. This is important as the ends of the plugs are ground while in the jig to give the correct diameter to be bored by the head. A set of three hardened setting plugs is required for each diameter of bushing to be bored.

This jig is simple to use but extremely accurate. A boring head is placed over the jig pivot. A set of plugs, to give the required diameter are placed in the three jig posts. The cutting tools are moved out to touch the setting plugs. They are then locked in place. Thus, the mechanic assigned to rebore a bushing has nothing to do with the tool setting.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Further comment on freight car derailments

BALTIMORE, MD.

TO THE EDITOR:

In my article published in the *Railway Mechanical Engineer* for January the rolling mass of the loaded car was stated as the principal factor in derailments. While this is true of the high gravity coal car, it should be said that it is not the principal cause for derailments of rigid, all-steel box cars.

The open top coal car is sufficiently flexible to permit the car to stand on a track excessively out of surface, without unloading the wheels on any corner of the car, when there is no side-bearing clearance. The modern all-steel box car is, however, so stiff that we can only prevent the load from being removed from the wheels on one corner of the car by spring action in the truck itself.

We are only interested, of course, in what might be termed the "weave" of the track in a length equivalent to the track centers of a box car and the extent of this weave can be considered as the amount that the elevation of the rail between the two wheels on one corner of the cars is out of the plane of three similar points on the rails.

We frequently find conditions where the weave of the track is as much as 1½ in. or 1⅝ in. and it would certainly seem desirable to have our stiff box cars go over a track with as much as 2½ in. weave without taking the load off the wheels on any one corner of the car. This will, of course, necessitate long travel springs. It is obvious that soft, long travel truck springs will lend themselves more readily to car roll than short travel, stiff springs. So it becomes important with the long travel spring, to have absorptive action to prevent rolling.

It is well understood that there are two causes of truck spring failures; one from springs going solid under car roll, which puts an excessive fibre stress in the spring at some point in the coil; the other from fatigue, which comes from a large number of workings through a large range of stress. Work absorption will largely prevent both types of failure because, by reducing the car roll, the range of stress causing fatigue failure will be largely reduced, and when their working range is reduced by elimination of car roll they will not go solid and break.

It would seem, therefore, that the spring travel on an open top coal car is of no particular importance, and all that is desired is to absorb work and prevent the car roll. On rigid box cars a long spring travel is imperative, with the obvious necessity for absorption to stop the resulting increased tendency to roll.

Car designers have considered the desirability of cross equalization of the load from one side of the truck to the other. This problem is difficult and expensive because with a rigid box car it is just as essential to have cross equalization with the light car as with the loaded car, and there must be provision for satisfactorily normalizing the car body, both when running light and fully loaded.

T. H. SYMINGTON.

Ode to a roundhouse foreman

MINDEN, LA.

TO THE EDITOR:

The roundhouse foreman sat in his office chair,
It was seven a.m., and the weather fair,
He had plenty of power and engine crews,
So he called the porter to shine his shoes.
He had a soft snap, no doubt of that;
Nothing to do but sit where he sat,
And smoke his pipe and read the news.
All kinds of engines and engine crews!

At seven-fifteen, the telephone rang
A rasping voice at t'other end sang,
"Want an extra north for eight o'clock,
Another one south on Fifteen's block,
An extra switcher for straight up Nine,
The hogs got sixteen on the main line,
Give us a 'Mike' and an extra crew
To pull 'em to clear for Number Two.

"An engine crew on One at one-forty-eight
To protect Seventeen, running five hours late."
Then he gets a call on the company 'phone,
"Here's a message, signed, 'Engineer Stone':
'One-Seven-One's sheared a cross-head key.
Have another engine for Number Three.
Cylinder head's busted and bent one guide,
Lost thirty minutes, puttin' 'er on one side!"

Says to the clerk. "It seems to me
That the 'Old Man's car's on Number Three."
Does a little thinkin', scratchin' his mug.
Says, "Bill, get a fire in 'Ole Spark Plug.' "
Some Government inspectors, lookin' her around,
Says, "She'll have to have her boiler checks ground."
It don't make him sore to hear the "Op" relate,
"Number Three reported fifty minutes late."

His engine inspector, "Salt Eatin' Jim,"
Opens the door and reports to him;
"Boss, Four-Two-Five is on the 'gyp,'
They've tied 'er up with a little pink slip.
I think them fellers are full of bugs,
Say we missed some o' the wash-out plugs!
I been puttin' water in the Five-O-Two,
An' she shows up with a busted flue!"

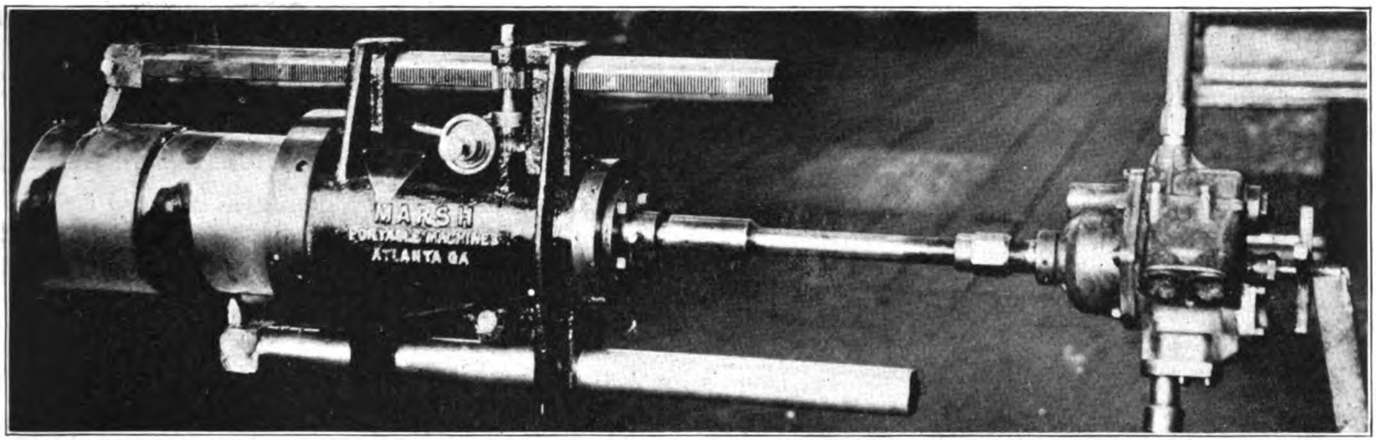
"It's time to go to dinner," the foreman said;
"I'll have to walk, 'cause my car is dead.
Bill, take a call on the Five-O-Two,
For three-forty-five and put in that flue."
And having nothing in the world to do,
Called the porter to shine the other shoe,
Sitting again in his office chair,
At peace with the world and without a care.

J. B. SEARLES.

Portable crank pin turning machine

On page 369 in the June, 1924, issue of the *Railway Mechanical Engineer,* appeared a description of a portable crank pin turning machine designed and patented by C. E. Marsh, 436 Hemphill Avenue, Atlanta, Ga. Since the publication of this description, many changes have been made in its design which have improved its adaptability to the work for which it is intended.

The principal advantage of this machine is that it will turn two journals on a crank pin at the same time, or will turn the rough and finish cuts at the same time on a crank pin having one journal and in either case, save one-half the time used by machines that have only one tool bar.



A portable crank pin turning machine using two tool bars provided with automatic feeds

The machine has two tool bars, each of which has an independent feed and feed control. The feeds are automatic and constant, unlike the old star feed. The bars are provided with a rapid travel to place the tool bars to a cutting position and to withdraw them at the end of the cut. A hand feed is also provided on each tool bar to be used when working out corners and fillets on crank pins. The tool bars are operated in the same way as the carriage on an engine lathe. The ends of the bars are provided with a tool holder that will allow the cutting tools to be set at any angle or position that is necessary to turn any kind of a crank pin job without having to offset or use bent tools.

The tool bars, which are made of high carbon tool steel, are 2-in. in diameter by 34 in. long. They can be made to any length to suit the needs of the class of work to be machined. The feed motion for the bars is generated from a worm on the spindle which is enclosed and runs in grease. The tool bars are fed out to the work by a gear rack which also acts as a key to keep the tool bar in proper alinement with the work to be turned.

The spindle is made of cast iron, tapered and bored out at the large end which is threaded internally to screw on to the adapters. The small end of the spindle is threaded on the outside for two thrust collars which also provides a means of adjusting any wear in either the spindle or rotating cylinder. The small end is bored and bushed for the driving and intermediate shafts.

The rotating cylinder is tapered to fit the spindle and is counterbored in the small end for the internal gear that drives the cylinder. The cylinder has two arms on each side that are bored out for the tool bars, and it is also cast with lugs and pads to carry the feed shafts and feed mechanism. The driving and driven gears are enclosed within the spindle and rotating cylinder which protects the operator. All gears and feed shafts are made of alloy steel and are heat treated. The machine is driven by a spur gear meshing with two intermediate gears in the small end of the spindle, which drives the internal gear keyed to the rotating cylinder.

The machine is provided with two master adapters that will adapt it to any size of crank pin. They also aline the

machine accurately with the axis of the crank pin without the use of calipers or other measuring devices. The machine can be set up and a cut started within five minutes. One master adapter is provided for crank pins having outside valve motion which is bored out to fit over the largest size crank arm fit and bushed to fit the smaller sizes. The adapter is threaded on the outside to fit the crank pin machine. Another master adapter is provided for crank pins having threaded and counterbored ends.

The machine has a cutting range from 3½ in. to and including 11½ in. in diameter, and up to 20 in. in length with the standard length bars furnished with the machine. The machine, without the tool bars, weighs about 155 lb. and with the two bars, about 225 lb. It may be driven either by an electric or air motor. A burnishing attachment can also be furnished with the machine.

Double head bolt threader and nut tapper

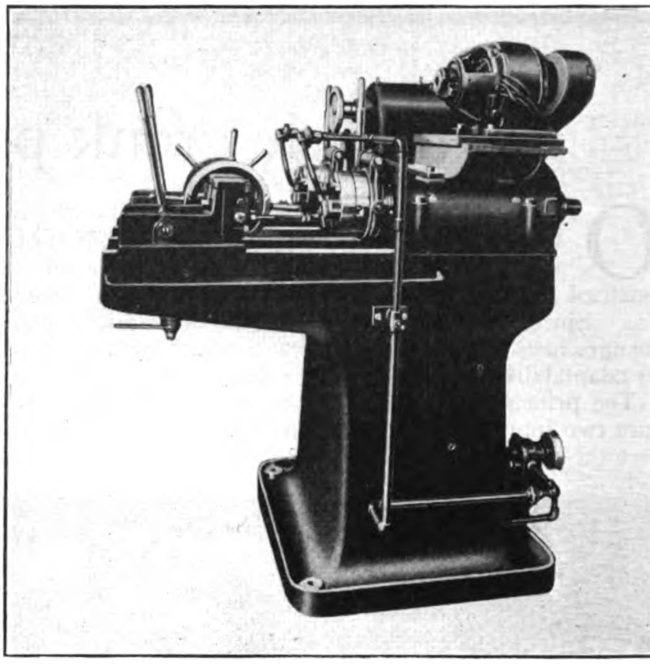
THE Landis Machine Company, Waynesboro, Pa., has placed on the market a new design of ½-in. double head threading machine which is used for cutting threads and tapping nuts either right or left-hand within a range from ¼ in. to 2 in.

It has a geared headstock and single pulley drive. The main spindle has bronze bearings, the purpose of which is to insure a long life under hard service conditions. This machine may be equipped with a lead screw attachment prior to its being placed in service. Only one lead screw is required for each carriage. The changes in pitches are taken care of by a substitution of gears.

The die head is opened and closed automatically at predetermined limits by the carriage, or by hand. The vise has a horizontal lateral, as well as a vertical centering adjustment, the purpose of which is to insure permanent alinement with the die. A full supply of cooling lubricant at the die head is maintained by a rotary pump. There is a special control valve at the die head for shutting off the oil supply when necessary. The frame is cast in one piece with a liquid tight bottom.

The driving pulley is mounted on top of the machine. The die head is driven by four speeds which give it 157, 226, 315 and 441 r.p.m. The machine is readily converted to motor drive, the power being transmitted from the motor shaft to the drive shaft by means of a belt. The motor is mounted on a plate located on top of the headstock to economize floor space and to prevent dirt and oil from accumulating on the motor parts.

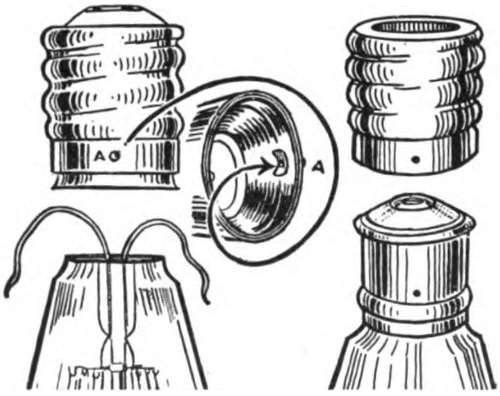
The floor space occupied is 4 ft. 1⅛ in. by 3 ft. 2⅜ in. The net weight of the belt-driven machine is 1,500 lb., while the net weight of the motor-driven machine is 1,750 lb.



Land's ½-in. double head, motor driven threading machine

Improved theft-proof lamps

AN improved type of the Kulp theft-proof lamp is now available which can be used either as an ordinary bulb, removable from the socket, or as a theft-proof lamp so that one stock of lamps can be used for both purposes.



Exploded view showing base and shell assembled, base and shell separate and shear pin which prevents the base from turning in the shell

The principle is simple. The threaded shell is held rigidly to the base by the small pin and washer (a). The lamp is inserted in the socket as usual until contact is made. If an extra twist is given, this pin is sheared off, allowing the lamp and base to turn freely in either direction while the shell remains in the socket. To remove, the bulb is broken, after which the shell may easily be reached and unscrewed. Since the lamp can only be removed by breaking, incentive to theft is removed.

The lamp itself is standard, carrying standard guarantees and sold at standard prices and discounts, exactly the same as for ordinary lamps. No changes in sockets are necessary and no extra attachments required. The patented theft-proof feature is part of the lamp base, built into the lamp at the factory.

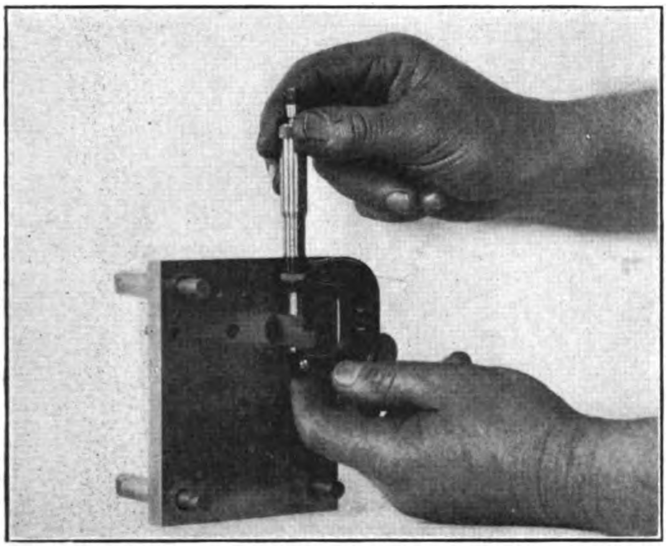
The possibilities of this lamp in railroad service are apparent for shops, stations, freight houses, office buildings, round houses and other exposed places. Figures submitted by some railroads show an annual loss from the theft of lamps varying anywhere from 15 to 30 percent

of their lamp purchases. One large system writes off $13,000 a year in this way. A smaller line admits to $3,000 loss in ten months. These are suggestive figures, rendered important since the entire amount can be saved.

These lamps are manufactured in all standard sizes and types by the Kulp Theft Proof Lamp Company, Chicago, and sold and serviced to railroads by the E. A. Lundy Company, Pittsburgh, Pa.

Taper parallel gages

A SET consisting of 10 parallel gages used for measuring small holes from 1/4 in. to 1 in. by .001 in. has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. The toolmaker will find these gages particularly useful in checking out-of-the-way holes, which are sometimes hard to measure on jig and fixture work. They can be used also in blind holes, slots, etc., in different positions, not only to determine the size of a hole, but also to find out whether or not the holes are out of round. They are made of high grade tool steel, hardened and ground to very close limits. Each strip is tapered and two strips placed together, form an adjustable parallel gage. The top, or measuring surfaces, are ground on a radius to insure a correct measurement.



Method of using the Brown & Sharpe tapered parallel gages

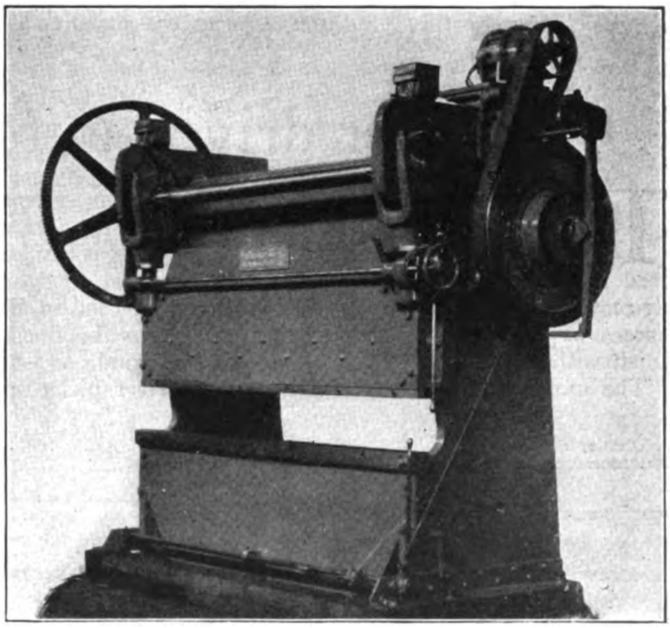
The accompanying illustration shows how they are used. The two strips, when adjusted to fit snugly into the hole, are measured across the two surfaces with a micrometer or a vernier caliper. In this manner the exact dimension is obtained in thousandths of an inch.

To facilitate the selection of the strips to be used in the hole to be measured, they are stencilled from *A* to *G*, inclusive. There is a plate attached to the inside of the lid of the box which holds the gages. On this plate are two parallel columns under the headings "size" and "use." If a hole is to be measured which has a diameter between 3/8 in. to 29/64 in., a glance at the plate will show that strips *B* and *C* are the ones to be used.

Cincinnati all-steel press brake

AN all-steel press brake used for bending, forming, flanging, or punching sheet metal for a variety of work used on freight and passenger cars, has been placed on the market by the Cincinnati Shaper Company, Cincinnati, Ohio. It is constructed of rolled steel plate in such a manner and with working stresses so low as to forestall trouble from carelessness, accident or defect. Furthermore, it eliminates the trouble from deflection in securing perfect bends and removes any limitations on the width of material handled by means of an open throat.

The two housings are cut from 3-in. solid steel plate and finished to 2 3/4 in. The ram and the bed of the machine are also cut from similar plate with heavy angles welded on for additional stiffness. The top of the bed is made from a steel billet machined in the shape of a saddle and solidly welded to the main plate. All gears, including the large one, are of steel and accurately cut. Double keys of the Kennedy type are used throughout. The screws are cut from high carbon, high nickel steel with a buttress thread to do away with the bursting effect on the connecting rods. A 5-in worm and wheel adjustment to the screw is operated either by hand or power. Quick bearings for the ram or hammer are gibbed in both directions and provide for the thrust encountered in punching. The clutch is of a multiple disc type, using special asbestos material on the friction surfaces. The flywheel is mounted on ball bearings, as is the idler pulley for the motor drive and the worm adjustment to the ram. All shaft bearings are bronze bushed. The worm and worm wheel adjustment and the power elevating device all run in oil, and



Cincinnati series 70 all steel press brake

all parts not protected in this manner are automatically oiled from the two oiling stations on top of the housings.

The control of the machine is either by foot treadle or hand lever, both of which can be moved at the wish of

the operator at any position across the front of the machine. An efficient brake is provided for stopping the machine immediately upon release of the clutch.

The machine has a 3-in. stroke, 5-in. adjustment and a throat clearance from the center of the dies of 8 in.; it runs at 30 strokes a minute. It can be furnished in any length from 4 ft. 6 in. to 10 ft. 6 in. between housings and has a capacity for making right angle bends, continuously and at one stroke in 10-gage steel, 10 ft. long, over a 1⅛-in. die to a radius equal to the thickness of the metal. It is furnished for either belt drive or arranged for motor drive, with the motor mounted on top of the housings.

A heavy and light duty metal cutting saw

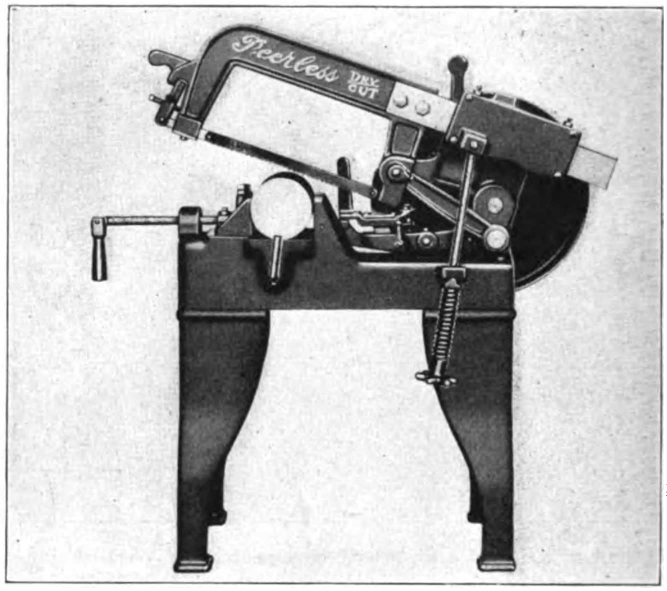
A NEW 9-in. by 9-in. size of the universal type of high speed metal sawing machine and an entirely new type of Dry Cut metal saw has been placed on the market by the Peerless Machine Company, Racine, Wis. The universal saw is built in two other sizes; namely, 6 in. by 6 in. and 13 in. by 13 in.

As in the case with the other two sizes, the intermediate capacity machine has the full square saw blade frame; quickly adjustable spring controlled feed pressure, with worm and ratchet type of feed; blade backing plate; swivel vise; three-speed gear box; lift on return stroke; automatic stop and lift of the saw frame to the starting position at the completion of a cut, and height and depth gages.

The machine has a capacity of 6 in. at a 45 deg. angle; takes a blade 14 in. to 17 in. long and has speeds of 125, 85 and 50 strokes per min. It requires a 1½-hp. motor designed to run at 1,700 r.p.m. to 1,800 and takes a floor space of 26 in. by 52 in.

The Dry Cut power saw has a capacity of 4½ in. by 4½ in. and is intended for general purpose work. The same principles of construction and operation have been incorporated in this machine to as great an extent as possible, as are embodied in the other Peerless metal cutting machines. These include the lift on the return stroke; quick adjustable feed pressure, spring controlled; automatic stop at the completion of a cut, and the advantage of the saw frame remaining in any position it is placed while setting stock. The machine runs at a comparatively low speed as it cuts without a lubricant. It is possible, under this condition, to run the machine at 100 strokes per minute when cutting low carbon steel.

A 10-in. blade is used in the machine, which makes



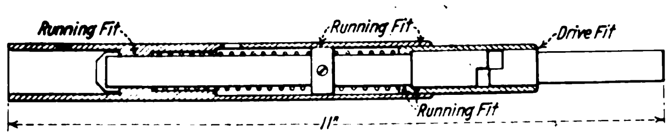
The Peerless 4½-in. by 4½-in. Dry Cut saw for general purpose work

a stroke of 4½ in. A ¼-hp. motor designed to run at 1,750 r.p.m. drives a 2¼-in. by 14½-in. pulley. It requires a floor space of 16 in. by 30 in.

Power driven automatic screw driver

THE illustration shows a power-driven screw driver, so designed by Stansell Automatic Screw Driver Company, Seattle, Wash., so that it can be used in all kinds of wood-drilling machines, electric or air-motors and also on drill presses. It can be used in all classes of woodwork from the plain rough to the finest finish without damage to the surface of the wood.

The motor will run continually as the driver picks up



A screw driver which automatically stops when the screw has been driven to the proper depth

the screws and releases them automatically at any set depth. The motor switch is turned on, the driver placed over the screw and pushed down.

The bit has a round shank where an adjustable drill-chuck is used on the motor, or is furnished with a number one taper shank when specified. The bit is made of special steel and fits into a dovetailed slot. It also holds the driver together. Tests made show that the bit will stand driving 2½-in. screws into hardwood blocks without lead holes.

By the tension of the springs, the bit is forced to the bottom of the screw slot; at that time the clutch ends come together and hold until the screw is driven home. The device has a depth collar that can be easily adjusted to drive screws to a depth of ¾-in.; the collar also holds the springs in position.

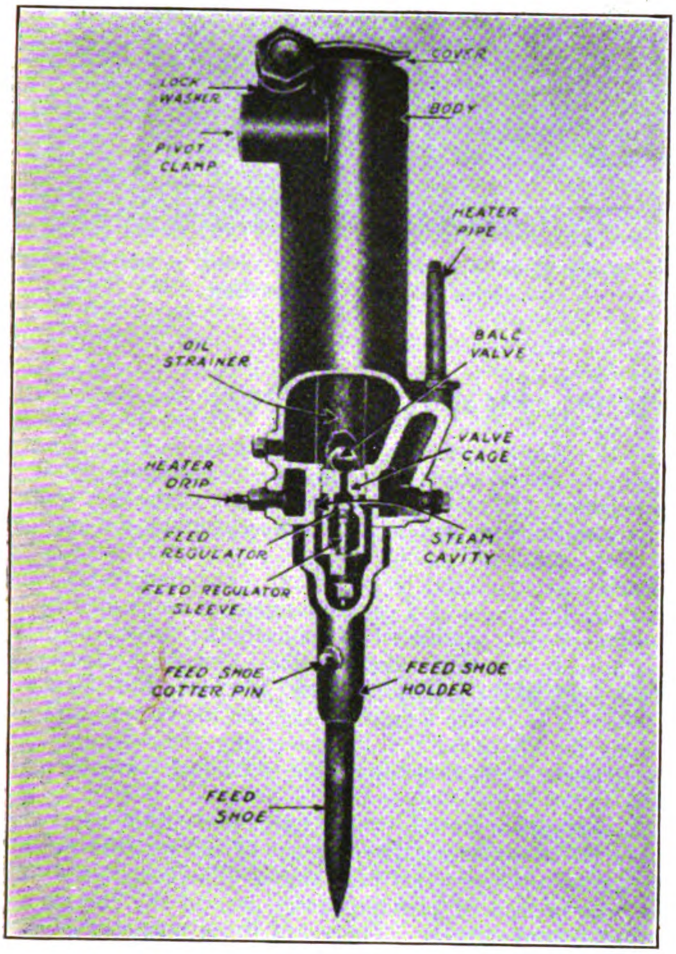
The barrel answers two purposes. It covers all working parts, leaving nothing exposed to catch the clothing or injure the operator and does not revolve while the screw is bring driven; the end of the barrel is a guide for the screw-head. It is provided with a liner for small screws.

The drivers are made in four sizes, No. 1, 11 in. long, takes screws from No. 20 down to No. 12; No. 2, 11 in. long, takes screws No. 12 and smaller; No. 3, 6 in. long, takes screws from No. 20 down to No. 12; No. 4, 6 in. long, takes screws No. 12 and smaller.

Where the operator stands over his work, a driver 11 in. long is furnished. For overhead work the 11-in. driver is furnished with an extension.

Swanson automatic flange lubricator

THE flange lubricator marketed by the United Manufacturing & Sales Corporation, Denver, Col., is automatic as to adjusting itself to the movement of the wheels and feeds oil only when the locomotive is in motion. The purpose of this device is to reduce both flange and rail wear to a minimum with the least possible amount of oil. As can be seen from the accompanying illustration, it contains no regulating valve or complicated parts to get out of order readily. It is heated by the air compressor exhaust steam to insure proper flow of oil in cold weather. Any oil from clean, light crude to asphaltum can be used.



Construction and parts of the Swanson automatic flange lubricator

There is nothing complicated in its operation. When the locomotive or car moves, the motion of wheels causes the ball valve in the lubricator to unseat, allowing oil to flow to the auxiliary reservoir. The regulator then controls the amount of oil fed to the flange. When the locomotive stops, the ball valve automatically returns to its seat, shutting off the flow of oil. It requires no regulation by the engineman as that is attended to when the kind or grade of oil to be used is decided on and the proper sized regulator applied in the lubricator. It adjusts itself to all local conditions; the movement of wheels, regardless of how much, does not displace the feed shoe and does not effect the operation of the lubricator.

It is provided with a good strainer to prevent the possibility of dirt in the oil getting to the regulator valve. When cleaning is necessary, the feed shoe holder and valve cage is removed after which the device is blown out with steam. The feed regulator should be free in the sleeve. The lubricator should be filled at terminals whether empty or not, as more damage may be done to a flange in 100 miles without oil than in 1,000 miles with oil. Inspectors should examine the lubricator to see that the feed shoe is properly located on the flange. The pivot clamp should be loosened, the shoe moved to place and the clamp tightened again. If the heater drip and steam cavity port is not open, the ⅜-in. plug below the heater pipe should be removed and the port opened with a small wire. Care should be taken when the locomotive is jacked up, that the feed shoe does not slip by the flange.

The method of applying the flange lubricator is simple. The suspension bracket is bolted to the locomotive frame or any other suitable place so that the arm will be properly located. The lubricator body should hang as nearly perpendicular as possible. The feed shoe should be located directly in the throat of the flange. The suspension bracket arm should always be located between the wheel and the body of the lubricator. The suspension arm must be 1¼ in. full round iron, the bracket about 3 in. by ¾ in.

The air compressor exhaust pipes should be tapped for the heater at a point where dry steam will be obtained. Heater pipes must be arranged so as to leave no water pockets to cause freezing. A ¼-in. pipe should be brought down from the air compressor exhaust underneath the boiler and divided centrally between the lubricants. The steam hose which connects the pipe with the lubricator heater should be of sufficient length to insure flexibility.

Tail rod construction for gas-engine compressor

THE Worthington Pump & Machinery Corporation, New York, has developed a tail rod construction for its small four-cycle, double-acting gas-engine compressors which serves the purpose of relieving the weight of the piston on the cylinder bore and also allows greater and more effective circulation of the cooling water through the piston and rod.

The box type frame is heavily ribbed, has a full-length bearing on the foundation and is carried above the center line of power stresses to eliminate weaving. Special Diesel iron is used for the power cylinders. These are made separately and bolted to the end of the main frame. Expansion between the inner and outer cylinder walls is taken care of by an expansion ring. All water passages are large and free from complications.

Inlet and exhaust valves are located at the top and bottom of the power cylinder, thereby equalizing stresses under temperature changes. The front and rear cylinder heads are symmetrical in shape and provided with large water-cooling spaces. This construction eliminates complicated castings and insufficient water-cooling space incident to construction where valves are located in the cylinder heads. The cylinder design also allows for easy inspection and adjustment.

The power piston and rod are water cooled, the circulating water entering the piston rod through the cross-

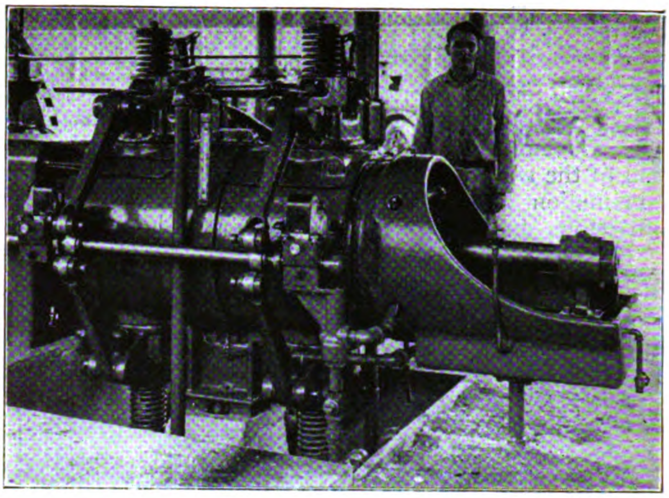
head and after circulating through the piston leaves through the tail rod. Connecting rods, shafts, crossheads, etc., are of forged, furnace-annealed steel.

A cast iron housing with hand-hole plates between the main frame and the compressor cylinder prevents the possibility of gas entering the crank case.

A belt-driven Massey governor, mounted on the side of the main frame is connected by levers to two balanced mixing valves, one for each end of each power cylinder. As an extra precaution, a safety flywheel stop short-circuits the ignition on overspeed.

Positive lubrication of the running gear is obtained by a reciprocating pump driven from the cam shaft. A forced-feed lubricator provides lubrication to the power and compressor cylinders and to the metallic packing provided on the power and compressor piston rods.

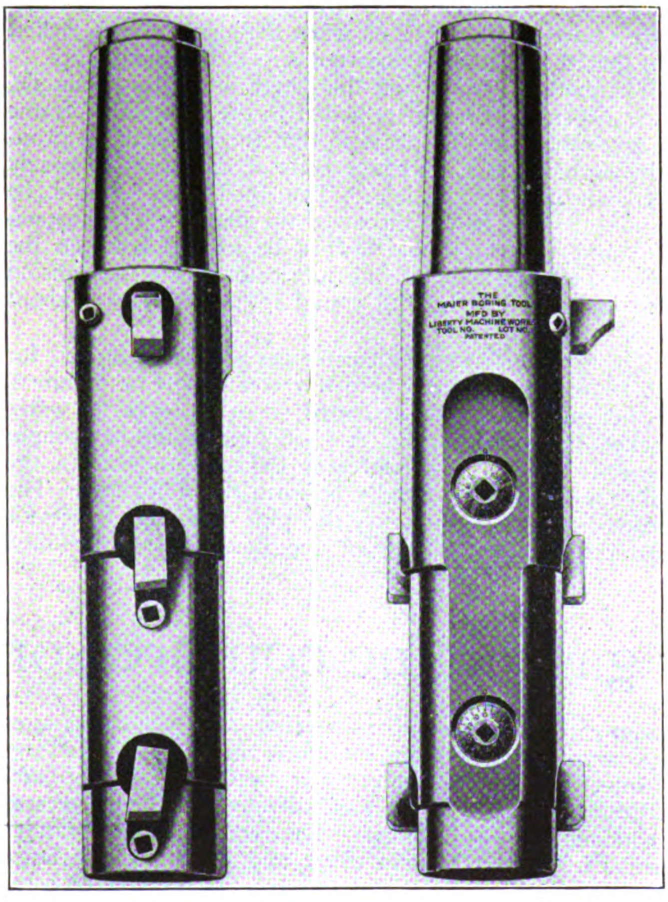
The compressor cylinders are of the Worthington feather valve type, provided with large water-cooling spaces for the cylinder and heads. Valve seats and guards for high pressure work are of hardened forged steel and for low-pressure and vacuum work, of hard cast iron.



The Worthington compressor, double-acting power cylinder with tail rod construction

Heavy duty car wheel boring tool

A CAR wheel boring tool designed for the heavy duty service strains placed on it in steady daily use has recently been placed on the market by the Liberty Machine Works, 906 North Market street, St. Louis, Mo. It has a triple arrangement of cutters, each set boring independently of the others. One set is for the rough boring operation and another for the finishing. These are so arranged that the finishing cutters engage immediately after the roughing cutters clear the work. After the finishing cut is taken, the cutter at the top of the tool chamfers the hub.



Maier car wheel boring tool provided with a wide range of cutter expension

Each pair of cutters is uniformly expanded to the desired size by means of a cam arrangement controlled by a micrometer dial graduated to thousandths, which insures close adjustments to the desired size. One of the features of the tool is the hardened cutter support, the purpose of which is to insure a rigid holder for the cutters and to prolong the life of the tool by preventing disintegration on the surfaces where the chips come in contact with the tool body.

Another advantage of these hardened cutter supports lies in the opportunity they present of setting the roughing cutters to the correct rake angle. The cutter is set at this rake instead of grinding away part of the cutters as is the general custom. There are three purposes in inclining the roughing cutters. They are to increase the life of the cutter, to decrease the tendency to heat and to permit faster feeds.

The Maier boring tool has a wide range of cutter expansion, the purpose of which is to reduce cutter costs by using more of the high speed steel on each set of cutters. The cutter locking device consists of a special screw lock which locks both cutters metal to metal. This arrangement insures uniformity of sizes and gives the rigidity of a solid bar.

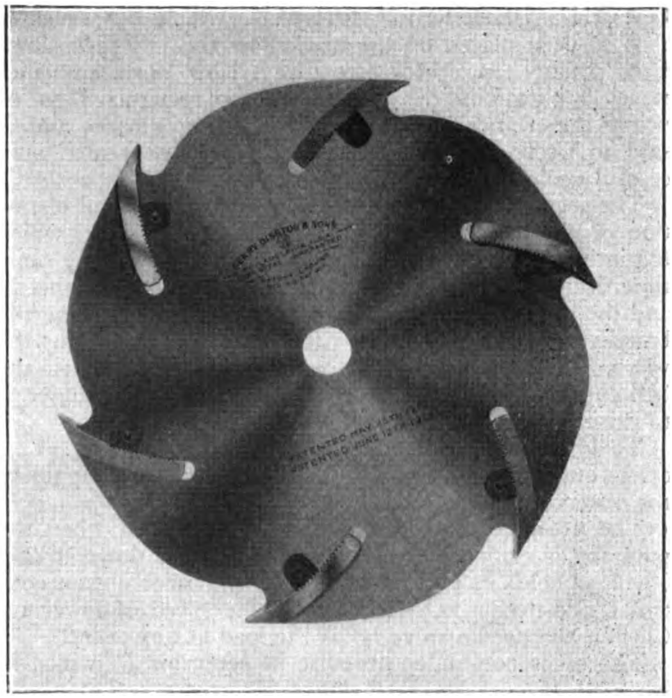
The tool is furnished in ten different sizes for boring steel, chilled or cast iron car wheels. The sizes for the former range from 3¼ in. to 4¼ in., to 6¾ in. to 9½ in. and for the latter, from 3 in. to 4¼ in., to 5¼ in. to 7¾ in.

THE FOREMEN'S SAFETY SCHOOL of the Milwaukee Association of Commerce has opened its sixth annual term with about 5,000 members registered. In the four months beginning with December 16 and ending next April, 46 meetings are to be held. About 50 volunteer speakers aid in the conduct of the school, which consists largely of lectures. These gatherings are described as miniature safety congresses. The need of such a school is indicated by the fact that in 1924 employers in the state of Wisconsin paid out for indemnities, under the workmen's compensation act, $4,200,479, the personal injuries reported in that time, fatal and nonfatal, being 22,766.

Inserted tooth saw and groover

In the Disston Ideal saw and groover, manufactured by Henry Disston & Sons, Inc., Philadelphia, Pa., the inserted tooth principle is employed for the production of grooving, molding, beading, tenoning, etc. The teeth, of special high-speed tool steel, are locked in sockets arranged spirally in the blade. Any tooth can be inserted or removed in a moment. Teeth can be obtained with any form of cutting edge, so that by choosing the proper tooth any desired shape or size of groove or slot can be cut. This enables the user to build up a saw for his special requirements or the work in hand and to change it at will.

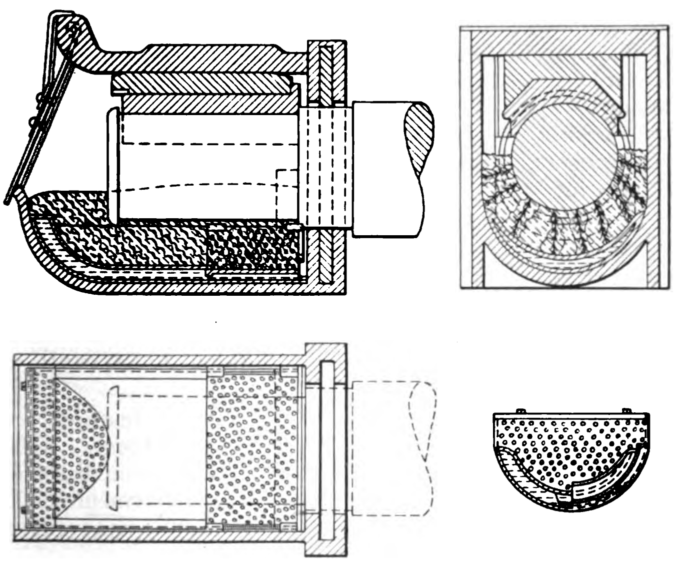
The teeth are set in the blade to provide clearance without swaging or setting. This insures that, regardless of the amount of wear, they will always cut the same width groove. Wear on the teeth is compensated for by moving them outward 1/16-in. or 1/32-in. A rack cut in the tooth fits a special lock and provides exact adjustment without troublesome measurements. With this type of saw, teeth of such hardness and toughness can be used that when sharpening is necessary, they are not filed but touched up in the saw with a whetstone or removed and sharpened on a grinding wheel. Nothing is touched but the teeth in sharpening or adjusting them. The width and clearance always remain the same. The blade never changes in diameter as it does when an old style saw is sharpened.



Wood saw with inserted teeth, adjustable for wear

Oil cup lubricator for journal boxes

The device shown in illustration is a lubricator for journal boxes which may be inserted in any of the standard forms of journal boxes, in present use without any alterations. The object of the device is to maintain a certain amount of lubricant aside from what is already normally held by capillarity in the waste or packing, which may be fed to it for a continued effective supply of lubricant to all parts of the bearings, particularly those that are more apt to be subjected to frictional heat.



A lubricator designed to efficiently and equally distribute the lubricant for journal boxes

The lubricating device is inserted in the lower part of any standard journal box and comprises a substantially closed lubricant container. The container consists of two pieces of sheet metal formed to fit the contour of the box. The lower wall or the one that rests on the bottom of the box, extends from the lower edge of the main journal box opening to the rear of the box. The upper wall contains two perforated sheets, one extending from the edge of the main box opening down to the point where the bottom of the box becomes parallel with the axle and the other extends approximately from the middle of the journal to the rear of the box. The upper end of the lubricator is covered by a perforated hinged lid.

In practice, the lubricator may be inserted through the main opening of the journal box and located to rest on the bottom wall of the journal box and beneath the journal. In the space provided between the journal fillet and the middle of the bearing is inserted a piece of special lubricating packing of twisted formation adapted to absorb and transmit the lubricating oil from the container to any portion of the journal. The remainder of the space between the bottom of the journal and the top of the lubricator is packed with the usual cotton waste or other packing material.

The oil ordinarily is poured in the journal boxes on the cotton waste after which it flows through the perforations of the cover plate and the wall, into the body of the lubricator between the upper and lower walls. At the perforations in the top of the lubricator the oil, coming in contact with the waste and the twisted packing is absorbed and distributed to the journal.

This device has been patented by William E. Christ, 21 Kolb avenue, Belmar, Baltimore, Md.

Readily controlled oil-operated jack

THE PEDERSEN OILJAK, which has recently been placed on the market by the Oil Jack Company, Inc., 1457 Broadway, New York, embodies novel applications of principles long recognized as of prime importance in the design of lifting devices and is said to overcome difficulties which have prevented successful use of these principles in the past.

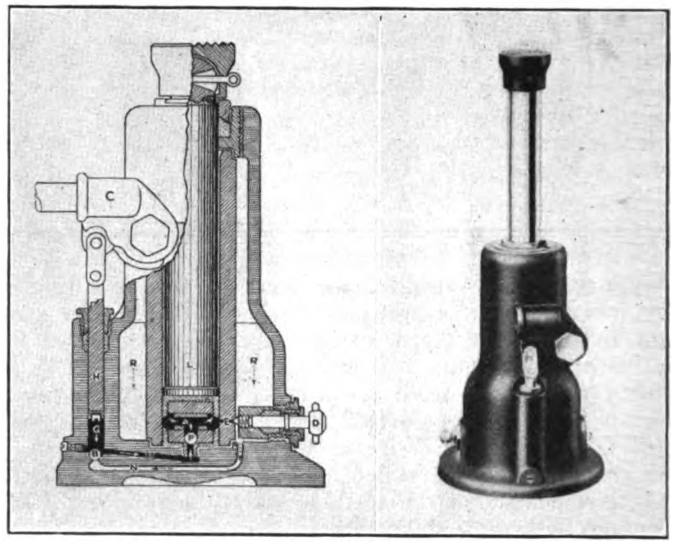
The sectional view explains the construction and operation of the jack. Raising the handle of the jack, which fits into socket *C*, raises the pump plunger *H*, at the same time drawing oil from the reservoir *R* through channel *N* and the ball check valve *B* into chamber *G*. Lowering the handle compresses the oil in the chamber *G*, seating the valve *B* and forcing oil through the channel *M* past the ball check valve *P* into chamber *A*, causing the plunger *L* to raise and lift the load.

To lower, the needle valve *D* is turned slightly. This opens outlet *E* and permits the oil to travel back again to the reservoir *R*.

The lifting of the load is always controlled when the pumping is stopped at any point of the up or down stroke. The load holds its position and is always under instant control. The needle valve *D* controls the speed of lowering. Closing the needle valve holds the load at any point.

The oil is not under pressure in reservoir *R*, which is in the main casting. Chamber *A*, where the pressure occurs, is entirely surrounded by a steel jacket, thus reducing to a minimum the possibility of leakage, expansion or breakage.

The swivel head is corrugated and hardened to insure a firm grip under a load. The ram is solid steel, 1⅜ in. in diameter, heat treated and ground. Adjustable oil-retaining packings prevent leakage. The rocker arm is rigidly constructed and provided with a positive stop. It oscillates on a heat treated fulcrum bolt and projects over the pump stem and thus protects it. The base is 6½-in.

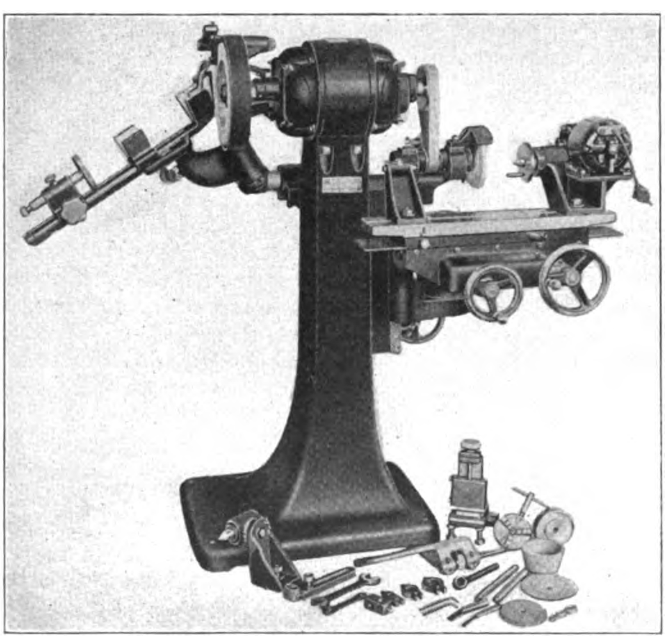


Pederson Oiljak which can be instantly stopped, under load, at any position of the handle

in diameter and the entire casting is amply strong to support many times the rated capacity of the jack. The jack can be obtained in 1, 3, 6 and 10-ton capacities.

Redesigned combination tool grinder

THE combination drill, cutter and reamer grinder, manufactured by the Gallmeyer & Livingston Company, Grand Rapids, Mich., has been redesigned with the object of making the machine more compact and convenient to operate.



Compact, motor driven tool grinder

The compactness has been obtained by providing for a motor drive, thus eliminating overhead shafting. The motor is fully inclosed to eliminate dust. Removable hand hole covers are provided for use when making bearing adjustments, cleaning the commutator, renewing brushes, lubricating, etc.

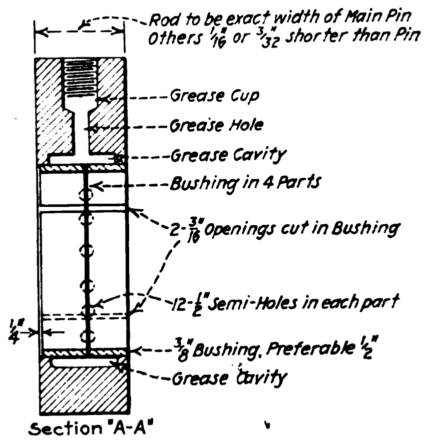
One end of the motor shaft is used for driving the cutter and reamer grinding wheel spindle. It is driven by an endless belt with the proper ratio of pulley size to provide for increased speed necessary in the case of the smaller diameter wheels used for cutter and reamer grinder work. This machine will grind either straight or taper work, as straight or cup wheels can be used.

The longitudinal, transverse and vertical features are controlled by convenient hand wheel movements. The maximum capacity of the machine is 9½ in. in diameter by 20 in. in length, with a longitudinal movement of 15 in., transverse movement of 7 in., and a vertical movement of 6¾ in.

A special motor headstock with a small lamp socket driven motor, mounted integrally with the headstock, is provided for handling cylindrical and internal grinding. The work spindle is driven by a worm, thus providing the necessary speed reduction and eliminating the necessity for an overhead drum. This feature is an advantage when grinding tools of different kinds.

Floating rod bushing requires no machining

Because of the heavy duty imposed on locomotive rod bushings, they require frequent renewal and it is desirable that the time consumed as well as the labor required in this operation, be minimized. Considerable time is involved under the present practice in the renewal of the bushings used in side rods. This is due principally to the fact that a considerable amount of machining is required. One object of the bushing shown in the illustration is to provide a construction which will simplify and expedite its renewal. All machine work is eliminated as well as the need for removing the side rods to provide access to the bushings or to enable the worn bushing to be removed. Further advantages claimed for this bushing are economy in the brass required, improved distribution of the lubricant to the bearing and equalized wear of the bushing.

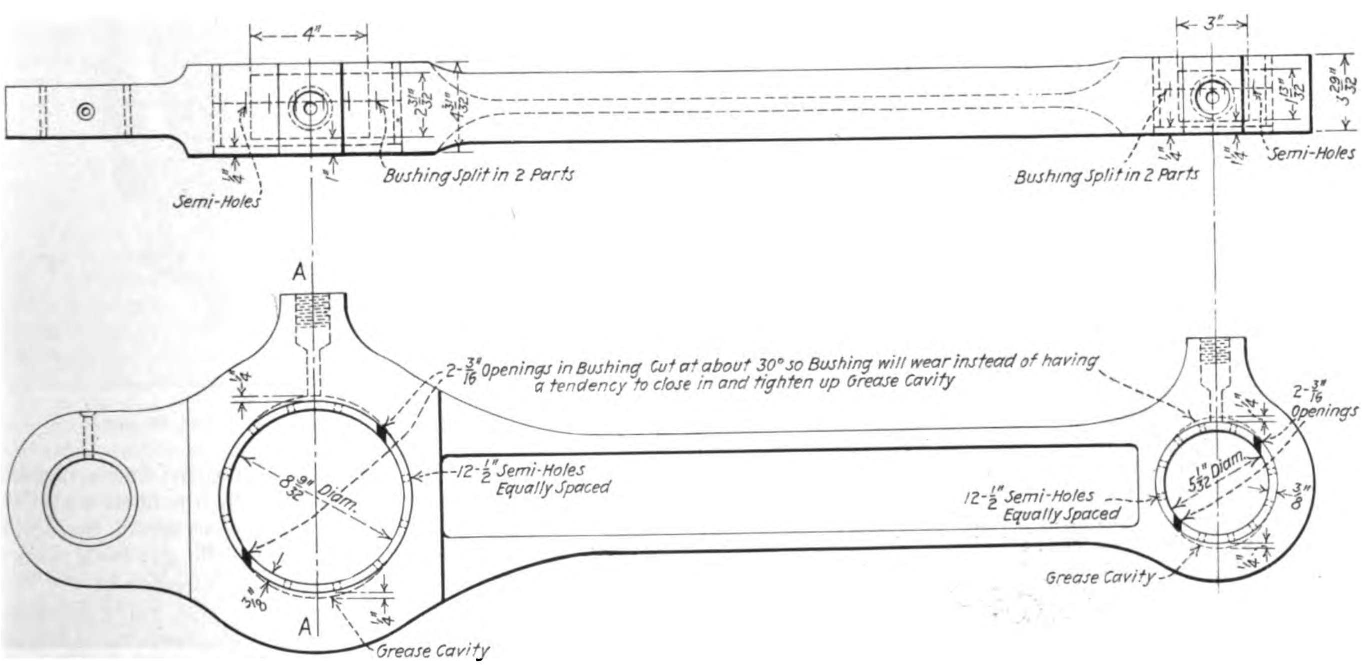


Cross-section of the bushing in the rod, showing how it is lubricated

The several bushing sections forming the complete bushing may be duplicates of one another which may be stamped from rolled brass or cast, in either case being made complete to the required dimensions. Hence, they are used just as they are stamped or cast without the necessity of any machine work.

The sections of the bushings may be considered as shims. After the parts which hold the rod in place have been removed the sections may be readily removed and replaced by hand. The usual practice is to fit rod bushings with extreme care in the belief that a close fit is required by reason of the heavy duty to which the bushings are subjected. These bushings float in the rod; i.e., they can move around so that the lubricant is equally distributed. On the particular application shown in the illustration, two 3/16-in. openings, cut at an angle of about 30 deg., are provided so that the bushing will wear instead of having a tendency to close in and tighten up the grease cavity located at the top and bottom of side rod.

The length of the bushing sections is somewhat less than 120 deg. which leaves between the ends of the sections sufficient space so that they will not become wedged or jammed against each other in the openings. The width of the sections is such as to provide for the usual fillet and at the same time allow for some lateral play, which is effective in the distribution of the lubricant. The inner edges of the bushing sections are provided with twelve ½-in. countersunk, equally spaced lubricant conveying and distributing notches or recesses which are of semi-circular outline. Circumferentially extending lubricant distributing channels or grooves are provided in the side rod at the top and bottom as is shown in the drawing, and are in communication with the recesses and with the division between the adjacent ends of the bushing sections. The upper channel may be supplied with lubricant through a passage leading from the threaded socket of the usual grease cup.



Method of applying floating bushing to a side rod

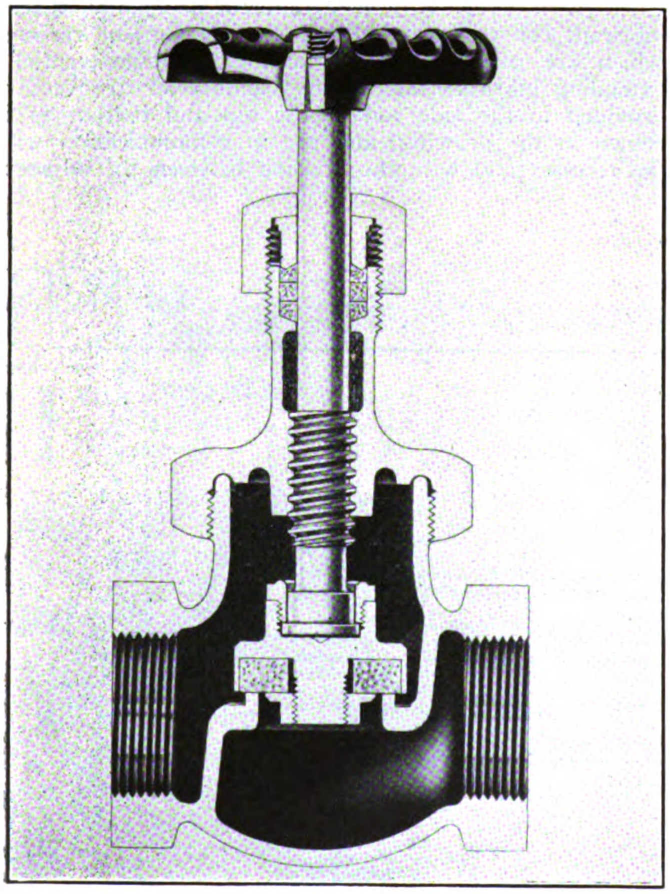
In renewing the bearing for the main crank pin, the clamping bolt is first removed from the bearing end of the connecting rod. The wedge will then come out and the rear half of the bearing block, or brass, is then

removed and the connecting rod pushed forward sufficiently to be out of the way to give free access to the bearing of the side rod on the crank pin. The side rod will be jacked up so as to relieve the bushing sections at the top from the weight of the rod as well as to provide sufficient clearance for the free movement of the bushing sections. The worn bushing sections can then easily be removed by means of a suitable tool and new bushing sections be freely pushed into place in the opening around the crank pin. With the bushing in three parts, it is easy to remove and replace. The connecting rod is then pulled back into place, the rear half of the bearing, the wedge block and bolt are replaced and the wedge driven in. This entire operation requires a comparatively short time and the locomotive is not taken out of service for renewing the bearing.

This bushing has been patented by J. E. Allen, Peru, Indiana.

Medium pressure bronze globe and angle valves

A LINE of medium pressure bronze globe and angle valves for 225 lb. working steam pressure has been placed on the market by Jenkins Brothers, New York. They have been designed to fulfill a need for a valve with



The Jenkins valve which operates under 225 lb. pressure

the renewable disc feature which will satisfactorily meet higher pressures than recommended for standard valves.

The bonnet and union are made in one piece to screw on to the outside of the body threads. This construction gives added strength to the body end. The bonnet hexagons are made especially large to provide for the easy removal of the bonnet without distortion.

The valves are regularly fitted with the Jenkins special No. 800 composition disc for high pressure work. No regrinding is necessary to insure a tight valve. The spindle is made of manganese bronze, with large, powerful threads which are all in contact when the valve is closed. The stuffing box is deep, with plenty of asbestos packing which is compressed by means of a bronze follower. A ventilated hand wheel of malleable iron is used.

The valves are furnished globe and angle with screwed or flanged ends, in sizes of ¼ in. to 3 in.

Unique fire extinguisher

A FIRE extinguisher, known as the Rego Fire Stopper, which has a number of unique features, has recently been developed by the Bastian-Blessing Company, Chicago. The first noticeable feature of this extinguisher is its appearance. The device is composed of

Position of the extinguisher when in use

two main units: a cone shaped container which is filled with dry powder and a small tank which is filled with CO_2 gas under pressure. When a fire is discovered, the device is turned up-side-down, the valve on the gas tank opened and the resulting steam of powder is directed at the base of the flame. When the fire is out, the valve is closed and the tank returned to an upright position. Only as much powder as is necessary to put out the flame is used.

The principle upon which the extinguisher is worked is that the powder in coming in contact with the flame, generates CO_2 gas and immediately blankets the entire fire and effectively smothers the flame. The use of CO_2 for power gives the device an effective range or from 25 to 30 ft. It is claimed that the extinguisher will put out all kinds of fire including those involving electric wiring. The powder is a non-conductor of electricity and can be used with safety in extinguishing electrical fires up to 160,000 volts.

News of the Month

PROMOTIONS AND APPOINTMENTS — I.C.C. — THE SUPPLY TRADE — CLUB AND ASSOCIATION NEWS — NEW TRADE PUBLICATIONS — NEW SHOPS

The Missouri Pacific plans to spend $248,000 for shop buildings and $40,000 for shop machinery during 1926. Appropriations have also been made for new equipment to include the purchase of 25 locomotives, 2,000 freight cars, 22 passenger cars and 8 passenger motor cars.

Representatives of the Brotherhood of Railroad Trainmen and the Brotherhood of Locomotive Engineers have filed a petition with the Public Service Commission of Kansas asking that a limit be set on the length of freight trains, on the ground that the longer trains have increased the hazard to trainmen. A statement issued by the brotherhoods alleges that injuries to trainmen have increased nearly 50 per cent in the past four years due largely, it is claimed, to the increased length of freight trains.

Central of New Jersey locomotive repairs criticized

The Interstate Commerce Commission has issued a report as a result of its investigation of the cost of locomotive repairs of the Central of New Jersey at outside shops during the fall of 1921 and during 1922 and 1923, finding that it exceeded the cost of substantially similar work in the company's own shops, and that the greater portion of such excess cost was an "unreasonable expenditure for maintenance of equipment and not in the interest of efficient and economical management as required by section 15a of the interstate commerce act." The present report relates to 117 locomotives repaired under five contracts and as to 50 locomotives repaired by the Crucible Steel Company, the commission finds that the contract, made in March, under a cost-plus basis, in preparation for the next winter, represents "improvidence in management which should be considered when fixing rates intended to yield the standard return contemplated by law."

Fuel economy contest on D. L. & W.

James Sullivan, machinist, Kingston, Pa., enginehouse, was awarded the first prize of $100.00 for having the best paper in the fuel economy contest recently held by the Lackawanna. Second and third prizes were awarded to Floyd E. Henneforth, fireman, Scranton division, and to H. F. Shaw, fireman, Buffalo division, respectively. A total of 126 papers were submitted by eligible employees in the contest. These papers were judged by a committee of five locomotive enginemen and five firemen, representing each of the five divisions of the railroad. The contest was open to enginemen, firemen, hostlers, coal chute operators, fire cleaners and other employees engaged in the handling of locomotive fuel in and around terminals. As each paper was received, it was given a number and the identity of the author was kept secret until after the awards had been made.

The object of the contest was to stimulate interest in fuel conservation and is in line with the efforts of the management to economize in the use of fuel for locomotives. During 1924, the Lackawanna consumed nearly 2,000,000 tons of coal for locomotive fuel. The contest brought out a number of good ideas of a practical nature and also showed the employees and management how they could co-operate in the prevention of waste in the utilization of coal.

Bangor & Aroostook complains of A.R.A. rules governing compensation for destroyed cars

The Bangor & Aroostook has filed a complaint with the Interstate Commerce Commission against the American Railway Association and its member roads asserting that the rules for compensation to be paid and settlement to be made for the use of cars destroyed on the line of a railroad other than the owner of the cars, and the interpretations of such rules adopted by the A. R. A., are unjust, unreasonable, arbitrary and in violation of section 1 of the interstate commerce act. Complainant particularly objects to the rules governing compensation for rebuilt cars at rates based on depreciation from the date that the car from which the reused materials were taken originally was placed in service. The commission is asked to establish reasonable rules, retroactive to October 30, 1922, the date when protest and complaint was made to the A. R. A.

The Bangor & Aroostook, according to the complaint, has had several hundred cars rebuilt and is obliged either to withdraw from the A. R. A. and its Mechanical Division, or to accept approximately 25 per cent of the depreciated cost of the car classified as "rebuilt" under the rules; or in other words, about one-third of the amount of the lien on such car authorized by the Interstate Commerce Commission in connection with equipment trusts. At a hearing before the arbitration committee of the Mechanical Division on December 14, 1922, the complaint says, the unfairness of the rule was urged not only by the Bangor & Aroostook but by many other car owners, including the Baltimore & Ohio; Central Vermont; Delaware & Hudson; Great Northern; Northern Pacific; Lehigh Valley; Missouri Pacific; Missouri-Kansas-Texas; Chicago, Rock Island & Pacific; St. Louis Southwestern; Wabash; Seaboard Air Line; Pere Marquette; Central of New Jersey, and Atlantic Coast Line. The subject was then referred to a special committee which had made recommendations for changes in the rules satisfactory to the complainant, but, says the complaint, the recommendations have not been submitted to members of the A. R. A. for consideration.

Railway labor bill

A most unusual situation is presented to Congress in the joint recommendation of the railroads through the Association of Railway Executives and representatives of organized railway employees, of a bill to do away with the Railroad Labor Board and provide a method of adjusting labor disputes which will be mutually satisfactory. Naturally it is a compromise, but the spirit in which it has been presented augurs well for the success of the plan, provided Congress enacts it into a law. Thus far the only important criticism voiced in the hearings has been from a representative of the National Association of Manufacturers, who feels that the public interest is not fully protected.

The provisions of the bill may be summarized as follows:

First. Any and all disputes shall be first considered in conference between the parties directly interested.

Second. Adjustment boards shall be established by agreement, which shall be either between an individual carrier and its employees, or regional, or national. These adjustment boards will have jurisdiction over any disputes relating to grievances or to the interpretation or application of existing agreements, but will have no jurisdiction over changes in rates of pay, rules or working conditions. It is, however, provided that nothing in the act shall be construed to prohibit an individual carrier and its employees from agreeing upon settlement of disputes through such machinery of contract and adjustment as they may mutually establish.

Third. A Board of Mediation is created, to consist of five members appointed by the President by and with the advice and consent of the Senate, with the duty to intervene, at the request of either party, or on its own motion, in any unsettled labor dispute—whether it be a grievance or a difference as to the interpretation or application of agreements not decided in conference or by the appropriate adjustment board, or a dispute over changes in rates

of pay, rules or working conditions not adjusted in conference between the parties. If it is unable to bring about an amicable adjustment between the parties, it is required to make an effort to induce them to consent to arbitration.

Fourth. Boards of arbitration are provided for, when both parties consent to arbitrate, also the method of selecting members of the boards and the arbitration procedure. Any award made by the arbitrators shall be filed in the appropriate district court of the United States and shall become a judgment of the court, binding upon the parties.

Fifth. In the possible event that a dispute between a carrier and its employees is not settled under any of the foregoing methods, provision is made that the Board of Mediation, if in its judgment the dispute threatens to substantially interrupt interstate commerce, shall notify the President, who is thereupon authorized, in his discretion, to create a board to investigate and report to the President, within 30 days from the date of the creation of the board. It is also provided that after the creation of such a board and for 30 days after it has made its report to the President, no change, except by agreement, shall be made by the parties to the controversy in the conditions out of which the dispute arose.

Locomotives installed and retired

Month—1925	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	139	7,208,534	170	5,602,619	64,420	2,593,971,635
August	147	8,384,262	210	5,866,368	64,357	2,596,489,549
September ...	129	7,981,464	229	8,601,871	64,257	2,595,729,142
October	150	7,284,850	266	7,930,271	64,142	2,595,082,839
November ...	112	8,862,352	394	15,659,796	63,869	2,588,576,535
Total for 11 months ..	1,604	....	...	....	......	....

Figures as to installations and retirements prepared by Car Service Division. A. R. A., published in form C. S. 56 A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Passenger cars installed and retired

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Full year, 1924..........	2,824	2,376	......
1925			
January-March	609	589	54,594
April-June	690	644	54,658
July-September	664	736	54,562

Figures from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division.

Labor board issues first report

The maintenance of the United States Railroad Labor Board, created on April 15, 1920, has cost $2,101,376, including the appropriation for the fiscal year ending June 30, 1926, according to a report the board has issued covering its activities. The report shows that 13,941 disputes were referred to the board from the date of its establishment to December 31, 1925, and that disposition was made of 13,447. Of this number 6,006 were local disputes. The remainder of the cases, totalling 7,935, were of a general nature, affecting large groups of railroads and their employees in any or all classes of service, and were requests for wage increases or reductions, or the general revision of rules governing working conditions.

The report covers government participation in railway labor disputes prior to the establishment of the Labor Board, including a summary of the Act of 1888, the Erdman Act of 1898, the Newlands Act of 1913, the Adamson Law, and procedure under government control. It also considers the growth of the present law and the Railroad Labor Board, describing labor conditions at the end of federal control, the labor provisions of the Transportation Act, and the activities of the bi-partisan board. In Part 3 of the report, devoted to the policy and activities of the Railroad Labor Board, it analyzes wage decisions, rule decisions, other questions considered by the board, the volume of work, the enforcement of decisions and the cost of maintenance.

Meetings and Conventions

At the annual meeting of the Cleveland Steam Railway Club, held at Hotel Cleveland, Cleveland, Ohio, January 4, 1926, the following officers were elected to serve during the coming year: President, G. L. Foster, assistant chief interchange inspector, Cleveland; first vice-president, C. Rhodes, division car foreman, Erie, Cleveland; second vice-president, R. A. Kleist, general car foreman, Baltimore & Ohio, Lorain, Ohio; secretary-treasurer, F. L. Frericks, New York Central, Cleveland.

Southeastern Car Foremen's Assn.

About 70 were in attendance at the annual meeting of the Southeastern Car Foremen's Association held at the Ansley Hotel, Atlanta, Ga., Friday, January 15. The one-day session, presided over by Livingstone Martin (B. & O.), president, was devoted to the reading and discussion of changes in M. C. B. rules. Despite the fact that orders had been placed in August or September, many complained of delays in receiving rule books, so it was decided to write to the American Railway Association to find out why rule books could not be issued earlier.

The following officers were elected: E. F. O'Connor (South-

Freight car repair situation

1925	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1..............	2,293,487	143,962	47,017	190,979	8.3
February 1............	2,305,520	139,056	47,483	186,539	8.1
March 1...............	2,313,092	141,192	43,855	185,047	8.0
April 1................	2,315,732	143,329	43,088	186,417	8.1
May 1.................	2,316,561	144,047	45,467	189,514	8.2
June 1................	2,320,261	146,998	48,988	195,986	8.4
July 1.................	2,326,734	150,530	47,938	198,468	8.5
August 1..............	2,335,223	153,674	43,607	197,281	8.4
September 1...........	2,333,849	149,705	47,473	197,178	8.4
October 1.............	2,335,475	139,551	40,020	179,571	7.7
November 1............	2,325,086	127,680	37,801	165,481	7.1

Month	Cars repaired: Heavy	Light	Total
December, 1924.........	66,615	1,288,635	1,355,250
January, 1925...........	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347
July	70,087	1,330,595	1,401,682
August	71,307	1,369,878	1,441,185
September	72,227	1,335,501	1,407,728
October	75,056	1,352,123	1,427,179

Data from Car Service Division reports.

Locomotive repair situation

Date, 1925	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
January 1..............	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1.............	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1................	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1.................	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1..................	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1.................	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1..................	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1
August 1...............	63,921	53,263	6,313	5,740	9.0	4,918	7.7	10,658	16.7
September 1............	63,812	53,261	5,902	5,514	8.6	5,037	7.9	10,551	16.5
October 1..............	63,701	53,058	5,337	5,552	8.7	5,091	8.0	10,643	16.7
November 1.............	63,604	53,371	4,450	5,387	8.5	4,846	7.6	10,233	16.7
December 1.............	63,368	52,643	4,656	5,370	8.5	5,355	8.4	10,725	16.9

Data from Car Service Division reports.

ern), president; W. C. Fields (Central of Georgia), 1st vice-president; C. C. Stone (Southern), 2nd vice-president, and C. W. Kimball (Southern), secretary and treasurer.

Southeastern Air Brake Club holds its first meeting

The first regular meeting of the Southeastern Air Brake Club, which was formed early in September, 1925, was held at the Piedmont Hotel, Atlanta, Ga., January 16. A general discussion followed the presentation of papers by E. F. O'Connor, air brake foreman, Southern, and M. S. Belk, general air brake instructor, Southern. The officers of the association are E. Z. Mann (Atlantic Coast Line), president; E. F. O'Connor (Southern), vice-president, and A. G. Huston (Westinghouse Air Brake Co.), treasurer.

The effect of the Diesel-electric locomotive on heavy electrification

The Metropolitan sections of the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers will hold a joint meeting in the Engineering Societies' building, 33 West Thirty-ninth street, New York, at 8 p. m. on February 18, to consider "The effect of the Diesel-electric locomotive on heavy electrification." The principal speakers will be C. H. Stein, assistant to the senior vice-president of the Central of New Jersey; Hart Cooke of the McIntosh & Seymour Corporation, and N. W. Storer of the Westinghouse Electric Company.

Western Railway Club discusses lubrication

Following a Dutch Treat dinner at the Hotel Sherman, Chicago, Monday evening, January 18, the Western Railway Club adjourned to the Crystal room and devoted the entire meeting to a discussion of the lubrication of railroad car equipment. The paper of the evening was presented by G. E. Dailey, supervisor of lubrication of the Chicago, Burlington & Quincy, who went into the matter in considerable detail and gave the members many intensely practical suggestions based on his investigation and study of lubricating methods as actually followed in freight yards, engine terminals and on the road. The most important point brought out by Mr. Dailey was the need for a well-trained force of oilers or packers which should not be considered non-productive, or in the class of common laborers, since, if their work is done well, fewer car men will be required on the repair track to change wheels set out on account of cut journals. It was brought out in the discussion that higher rates of pay than now generally given to oilers and packers are necessary in order to attract a somewhat higher grade of men to this work and make them willing to stay on the job, once they have learned the details.

Annual meeting of Central Railway Club

The thirty-seventh annual dinner of the Central Railway Club was held at the Hotel Statler, Buffalo, N. Y., Thursday evening, January 14. As indicated at the annual meeting of the club, which was held during the afternoon, the membership has grown rapidly during the past year and is now in the neighborhood of 1,650.

There were about 1,200 guests at the dinner in the evening, more than 80 of whom went to Buffalo from New York on a special train over the Delaware, Lackawanna & Western. Charles C. Pierce, of the General Electric Company, Boston, Mass., was toastmaster, and addresses were made by John M. Davis, president of the Delaware, Lackawanna & Western; E. T. Whiter, vice-president and general manager of the Central Region, Pennsylvania Railroad; and Rev. Henry A. Mooney.

At the business meeting in the afternoon announcement was made of the election of the following officers: President, A. E. Calkins, superintendent rolling stock, New York Central; vice-presidents, F. M. Barker, superintendent, Lehigh Valley; R. E. Woodruff, superintendent, Erie Railroad; and E. F. Ryan, terminal superintendent, Buffalo, Rochester & Pittsburgh.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4 to 7 inclusive, Hotel Roosevelt, New Orleans, La.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.
Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 21-23.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

American Sciety for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting February 9. A paper on Autobus Competition by R. A. C. Henry, director, Bureau of Economics, Canadian National.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting February 11. Younger men's night. The following papers will be presented: Interchange inspection and methods to assist same, by J. M. Getzen, assistant chief interchange inspector, Buffalo; Importance of station Accounting and its Relation to the Efficient Operation of a Railroad, by John J. Jones, chief clerk to agent, Nickel Plate, Buffalo; Signal Maintenance, by E. F. Hood, assistant chief signal supervisor, N. Y. C., Buffalo; My Experience in the Mechanical Department, by Tallman Ladd, assistant enginehouse foreman, Pennsylvania railroad, Oil City, Pa.; Divisional Car Distribution, by John Xortner, car distributor, Erie, Buffalo, and Emergency First Aid Treatment by Employes, by Raymond Mitchell, clerk, trainmaster's office, Lehigh Valley, Buffalo. Entertainment by local talent.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting, February 11. A paper on electricity as applied to railroads will be presented by A. J. Manson, manager heavy traction railway department.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmith's Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

International Railway Fuel Association.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting February 9. A paper on the International Railway Congress will be presented by Julius H. Parmelee, director, Bureau of Railway Economics.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting February 15. A paper will be presented by W. H. Finley.

Supply Trade Notes

W. W. Sayers, chief engineer of the Philadelphia plant of the Link-Belt Company, has been appointed chief engineer of the company, with headquarters at Chicago.

The Harnischfeger Sales Corporation, Milwaukee, Wis., has moved its Birmingham, Ala., office from 431 First National Bank building to 401 Pioneer building.

The Tool Steel Gear & Pinion Company, Cincinnati, O., has moved its Chicago district office to Room 648 McCormick building. Walter H. Evans is district representative.

G. T. Aitken, formerly sales manager of the Vonnegut Machinery Company, Indianapolis, Ind., has become associated with the Indianapolis plant of Fairbanks, Morse & Co.

G. L. Hulben has been added to the sales force of the Chicago branch of the Ludlum Steel Company. The general offices and works of this company are at Watervliet, N. Y.

J. I. Byrne, formerly chief engineer of the Texas Carnegie Steel Association, Galveston, Tex., has been appointed general manager of the Orange Car & Steel Company, Orange, Tex.

Andrew F. McCoole, with office at 2091-2092 Railway Exchange building, St. Louis, Mo., has been appointed railway representative in that territory of the Murphy Varnish Company, Newark, N. J.

The Okonite Company, Passaic, N. J., and The Okonite-Callender Cable Co., Inc., have opened a new branch office in the Hoge building, corner Second avenue and Cherry street, Seattle, Wash.

R. M. Chissom, special representative of the Lehon Company, with headquarters in Chicago, has resigned to become manager of railway sales of the Otley Paint Manufacturing Company, Chicago.

F. C. Horner has been appointed assistant to the vice-president of the General Motors Corporation, New York, in charge of development of the commercial motor vehicle field on steam and electric railways.

The F. F. Barber Machinery Company, Ltd., Foy building, 32 Front street, West Toronto, Ontario, will in future represent the Geometric Tool Company, New Haven, Conn., exclusively in the province of Ontario.

M. J. Miller has been appointed sales engineer in charge of the Detroit district of the Diamond Power Specialty Corporation, Detroit, Mich. Mr. Miller was in charge of the Philadelphia district for several years.

W. O. Jacquette, eastern sales manager of the Pullman Car & Manufacturing Corporation at New York, in order to take a much needed rest has tendered his resignation, to take effect on the appointment of his successor.

The National Lock Washer Company has changed its Chicago address from 1535 Lytton building to 1103 Straus building. J. Howard Horn, sales manager of the company at Newark, N. J., has been elected general sales manager.

George N. DeGuire, formerly manager, department of equipment of the United States Railroad Administration, has been appointed assistant to the president of the Locomotive Firebox Company, with headquarters at Chicago.

Frank C. Webb, representative of the Railroad Supply Company, Chicago, with headquarters at Denver, Colo., and at one time a division superintendent on the Colorado & Southern and on the Great Northern, died at Denver on January 12.

The Erie Foundry Company, Erie, Pa., has opened the following district sales offices: At 1120 Myrtle Ave., Plainfield, N. J., in charge of H. Terhune; 549 Washington Blvd., Chicago, in charge of L. F. Carlton, and 408 Donovan building, Detroit, Mich., in charge of R. B. McDonald.

J. H. Redhead, formerly assistant to vice-president and assistant manager of sales of the National Malleable & Steel Castings Company, Cleveland, Ohio, has been elected vice-president and general manager of the Columbus Malleable Iron Company, with headquarters at Columbus.

George H. Charls, vice-president and general manager of the United Alloy Steel Corporation, Canton, O., has been elected president, to succeed E. A. Langenbach, who has been elected chairman of the board. L. G. Pritz, vice-president in charge of operations, will succeed Mr. Charls.

The Mechanical Manufacturing Company, Chicago, has opened an office at 323-E Hudson Terminal building, 30 Church street, New York. J. A. Keating, representative, with headquarters at Chicago, will be in charge. H. E. Johnson, representative at Chicago, has been transferred to the eastern office.

The Southern Wheel Company, Pittsburgh, Pa., has opened a new office in the Munsey building, Washington, D. C., in charge of S. C. Watkins, special representative, who was formerly located at Atlanta, Ga. The Atlanta office in the Candler building is now in charge of C. C. Cox, representative.

William B. Albright, a director of the Sherwin-Williams Company, Cleveland, Ohio, died suddenly on December 28 while visiting in Cleveland. He was born in Philadelphia, Pa., on July 17, 1855, and has been connected with the Sherwin-Williams Company since January, 1885, serving as a director since 1894.

The Nazel Engineering & Machine Works, Philadelphia, has purchased from the T. C. Dill Machine Company all rights and titles to the Dill slotter and will manufacture it in connection with the Nazel air hammer. Robert Miller, long associated with the Dill Company as superintendent, will join the Nazel organization.

The Earle Gear & Machine Company, Philadelphia, Pa., has transferred its designs, patterns, patents and good will covering the Earle centrifugal pump to the Aldrich Pump Company, Allentown, Pa. The Earle Company will, however, continue the manufacture and sale of its line of cut gears, movable bridge operating machinery, cold metal saws and other special equipment.

F. O. Paul has been appointed service manager of the automotive car division of the J. G. Brill Company, Philadelphia, Pa. For several years Mr. Paul was connected with the sales and service departments of the Timken Roller Bearing Company, Canton, Ohio, and was previously affiliated with the International Motor Company as chief inspector at its New Brunswick, N. J., plant.

James H. Watters has been appointed assistant to the president in charge of sales of the New York Air Brake Company, New York. K. E. Keiling, who has served for some time in the office of the purchasing agent of the New York Central, has been appointed purchasing agent of the company, with headquarters at New York, succeeding W. R. Brown. B. J. Minnier, vice-president in charge of production at Watertown, N. Y., has resigned.

The Stuebing Truck Company, of Cincinnati, Ohio, and the Cowan Truck Company, of Holyoke, Mass., manufacturers of lift trucks, were merged recently under the name of the Stuebing-Cowan Company. While the directing headquarters of the new company will be at Cincinnati, Ohio, the Cowan truck division will continue its operation at Holyoke, Mass. Sales offices will be maintained in all of the principal cities with stocks located at convenient points to provide prompt service.

K. D. McKoll has been appointed Canadian district manager of the United States Electrical Tool Company, with headquarters at Toronto, Ont., and Ralph E. Bell has been appointed district manager for New England, with headquarters at Boston, Mass. The American Equipment Company of Detroit, Mich., will handle the sale of U. S. electrical drills, grinders and polishers for Metropolitan Detroit. Selling arrangements with the Backmeier Sales Corporation, Cincinnati, Ohio, have been withdrawn, the United States Electrical Tool Company having arranged to travel its own salesmen in the southern states.

Frank Purnell has been appointed assistant president of the Youngstown Sheet & Tube Company, Youngstown, Ohio, and will be in charge of the company's affairs in the absence of the president. Lewis E. Wallace, assistant district sales manager at Cleveland, has been appointed manager of the Detroit office, succeeding G. W. Bostwick, resigned. During the war Mr. Purnell was connected with the steel section of the War Industries Board

in Washington and after the war became vice-president of the Consolidated Steel Corporation, New York. Later he was made vice-president of the Bethlehem Steel Corporation in charge of its export trade and in 1923 re-entered the employ of the Youngstown Sheet & Tube Company.

Charles Albert Gould, founder of the Gould Coupler Company and the Gould Storage Battery Company, died on January 6 at his home in New York City. Mr. Gould was a pioneer in the development of automatic car couplers, electric train lighting, vestibule passenger cars and other railroad devices. He was born in Batavia, N. Y., on January 13, 1849. He became an accountant in Buffalo about 1869 and subsequently served as postmaster of Buffalo and collector of customs. About 1880 he organized and became president of Gould & Stimson, and in 1890 this was developed into the Gould Coupler Company. He remained at the head of this organization until January 1, 1925, when he disposed of his interest in the business to serve as president of the Gould Realty Company and the Gould Securities Company.

Charles A. Gould

The Sheffield Steel Corporation, Kansas City, Mo., has been organized to acquire all of the stock of the Kansas City Bolt & Nut Company and to take over all the property of the latter company consisting of four units located at Kansas City which include the Sheffield steel mills; a bar iron and rail re-rolling mill; bolt, nut and forgings plant; blue annealed steel sheet mill and an additional open hearth furnace now under construction. W. L. Allen, who was president of the Kansas City Bolt & Nut Company, is president of the Sheffield Steel Corporation and the other officers are: R. L. Gray, vice-president; L. L. Middleton, secretary; H. R. Warren, treasurer; Ernest Baxter, general manager of sales; J. C. Shepherd, assistant general manager of sales, and J. W. Anderson, assistant general manager of sales. W. L. Allen, president, recently acquired a controlling interest in the Kansas City Bolt & Nut Company, and through the new corporation has now acquired practically all of its common stock.

C. D. Foltz, representative of the Westinghouse Air Brake Company in charge of the Denver and Salt Lake City offices, has been appointed assistant western manager of the company, with headquarters at Chicago. Mr. Foltz has been connected with the railroad business for many years. At the age of fifteen he served as a telegraph operator of the Wabash. He then served consecutively as a fireman of the Chicago, Milwaukee & St. Paul; as an engineman of the Union Pacific, Denver & Gulf; engineman of the Atchison, Topeka & Santa Fe, and traveling engineer. He entered the employ of the Westinghouse Air Brake Company in 1910 as an inspecat Salt Lake City, Utah, and was later promoted to mechanical expert and representative at that office. In 1923 his field of activity was widened by the inclusion of the Denver, Colo., office, and his headquarters were moved to that city.

C. D. Foltz

American Company Incorporated to manufacture and sell Holzwarth gas and oil turbines

The Holzwarth Gas Turbine Company of America, recently incorporated in Delaware, has acquired the patents and rights to manufacture and sell in the United States and Canada the Holzwarth gas and oil turbines which have been developed and built by Thyssen & Company, Mulheim-Ruhr, Germany, and which possess thermal efficiencies comparable with existing prime movers.

Hans Holzwarth, inventor of the turbine and former chief engineer of the Thyssen Works, is vice-president and engineering director of the American company. The offices of the American company are located at 504 Standard Oil building, San Francisco, Cal., and its European address is care of Thyssen & Company, Mulheim-Ruhr, Germany.

The American company has negotiated certain contracts with the Thyssen firm in Germany and prolonged tests under commercial conditions are to be run on a 5,000 kilowatt gas turbine and small oil turbine at the Thyssen Works in the near future. Invitations to witness these tests have been extended by the American company to a number of engineers, manufacturers and power-producers in the United States and in other countries.

Car builders rewarded for suggestions

Under the plan of employee representation in the shops of the Pullman Car & Manufacturing Corporation, awards have been made to individuals for suggestions for improvements found worthy of adoption. In the central toolroom an employee suggested a device for reclaiming sockets for drills, a device for re-bushing air hammer cylinders, and a device for holding broken drills, permitting their further use. The suggestions of an employee in the cabinet department for a device for holding drills that have been broken, permitting their further use, was also adopted. In the passenger steel erecting department an award was made for the suggestion that outside body end sheet, step riser channel, door header and platform plates be applied while the underframe is lined up for riveting in the passenger steel erecting department. An award was made in the steel cabinet department for an improved method of assembling section partitions. Other suggestions which were adopted included a device for an improved dust cap for electric reamers, a modification in double berth latch bolt manufacture, the suggestion that the cold chisel be rounded off half oval for use in cutting off screws on partitions and a suggestion for the use of two whistle valves of the poppet type in place of a three-way valve on overhead reamers.

Plans for Merger of equipment builders

The J. G. Brill Company, Philadelphia, Pa., for years engaged in the construction of street railway equipment, is one of the principal figures in a combination of transportation equipment builders announced by President Samuel M. Curwen. The combination involves companies having total assets of $150,000,000 and outstanding capital stock issues of nearly $75,000,000, with the American Car and Foundry Company, of New Jersey, the dominating factor.

Under some designation preserving the name Brill, which has been associated with Philadelphia manufacturing history since 1869, a new corporation will be organized in Delaware to take over a majority of the outstanding stock of the Brill Company and the American Car & Foundry Motors Company, a Delaware corporation, recently organized. The latter corporation owns all the capital stock of the Hall-Scott Motor Car Company, of California, and more than 90 per cent of the capital stock of the Fageol Motors Company, of Ohio. The American Car & Foundry Company, of New Jersey, manufacturers of railroad equipment, will own a majority of the voting stock of the new corporation.

The Hall-Scott Motor Car Company manufactures gasoline motors used in motorbuses, trucks, marine equipment and airplanes. The Fageol Motors Company manufactures the Fageol bus. The American Car & Foundry Company, of New Jersey, represents a consolidation of eighteen companies engaged in the manufacture and sale of railway passenger and freight train cars for domestic and foreign service, and the manufacture of steel and iron parts. It has plants at various places in the United States. In addition to being a large builder of street and elevated railway passenger equipment and car trucks, the Brill Company also has engaged in recent years in the building of engines and motorbuses and gasoline and gasoline-electric passenger cars for the steam railroads.

Trade Publications

SILENT CHAIN DRIVERS.—A line drawing showing the "Renold" segmental bearing is contained in the four-page folder issued by the Boston Gear Works Sales Company, New York.

AIR COMPRESSORS.—The construction details and operating characteristics of single-stage centrifugal air compressors are given in a four-page, illustrated folder issued by the General Electric Company, Schenectady, N. Y.

GOLD'S VAPOR SYSTEM.—Bulletin No. 29 covering Gold's vapor system, with colored inserts showing application to the various types of passenger train cars, has been issued by the Gold Car Heating & Lighting Company, Brooklyn, N. Y.

WASHFOUNTAINS.—Five types of washfountains for collective and individual use in office buildings, industrial plants, clubs and other large institutions are illustrated and described in the pages of an attractive 28-page catalogue issued by the Bradley Washfountain Company, Milwaukee, Wis.

SAFETY VALVES.—"The High Pressure Steam Testing Laboratory of Manning, Maxwell & Moore, Inc.," is the title of a catalogue issued by Manning, Maxwell & Moore, Inc., New York, illustrating the use of Consolidated safety valves on the large 1,200-lb. boiler recently installed and put into operation at its Consolidated Safety Valve Company Works in Bridgeport, Conn.

WROUGHT IRON PIPE.—The A. M. Byers Company, Pittsburgh, Pa., has a new four-reel Pathé production entitled "The Little Red Ball," which may be secured by organizations generally interested in the manufacture of wrought iron pipe. This film shows hand puddling of genuine wrought iron, including diagrammatic views of the interior of a puddling furnace, the drawing of the "Little Red Ball," squeezing, rolling of muck bar, cutting, piling, reheating, rolling, etc. The methods of forming and welding flat strips of skelp into pipe are explained by animated drawings.

BUS POWER—This is a 63 page book which is presented by the Continental Motors Corporation, Detroit, Mich., in an endeavor to familiarize mechanical men with some of the main factors involved in gasoline power for motor buses. Chapters are devoted to a study of conditions to be taken into consideration in the selection of a bus power plant for operation in a particular locality, and the advantages of certain types of motors are discussed in relation to their adaptability to this class of work and to economical operation. Other chapters are devoted to the importance of proper maintenance, the provisions necessary to obtain best maintenance results, and a discussion of the qualifications of men who handle busses with particular reference to their responsibility as regards the power plant.

HEALD ANNIVERSARY.—A 30-page brochure, commemorating its one hundredth anniversary, has been issued by the Heald Machine Company, Worcester, Mass. The cover design of this booklet, which is entitled "The first ledger," is a replica of the old original ledger, the first pages of which bear the date of January 7, 1826. In its earliest days, the Heald business was a machine jobbing shop, and later a woodworking machinery shop. In 1890, after the death of Stephen Heald, the company became interested in the manufacture of grinding machines and has since added to its line of tools the drill grinder, the center grinder, the surface grinder, the cylinder grinder, internal grinders and miscellaneous grinding attachments. A number of illustrations show the first and latest models of these machines.

"CERTIFICATES OF MECHANIC" will be issued by the Chicago, Rock Island & Pacific to all its shop apprentices who have completed their four-year apprentice course in Rock Island shops. These certificates will bear the name of the graduate apprentice, the number of years he has served and the place of his employment, and will be signed by the superintendent of motive power and the master mechanic of the shop where the apprentice completed his course. The certificates will be engraved and appropriately decorated.

Personal Mention

General

CARL B. SMITH has been appointed assistant to the mechanical superintendent Boston & Maine with headquarters located at Boston, Mass.

W. R. MEEDER has been appointed superintendent of motive power of the Missouri & North Arkansas, with headquarters at Harrison, Ark.

THE TITLE OF C. H. TERRELL, assistant superintendent of motive power of the Chesapeake & Ohio, has been changed to assistant to the chief mechanical officer.

E. P. MOSES, general equipment inspector of rolling stock of the New York Central, has been appointed engineer of rolling stock with headquarters at New York, succeeding P. W. Kiefer.

P. W. KIEFER has been appointed chief engineer of motive power and rolling stock of the New York Central, succeeding F. H. Hardin, with headquarters at New York. He entered railway service as an apprentice in the mechanical department of the Lake Shore & Michigan Southern (now a part of the New York Central) and in 1916 entered the equipment engineering department. He then served as locomotive designer and as leading draftsman and later worked on dynamometer car tests. In July, 1920, he was promoted from the position of chief draftsman on locomotives in the equipment engineering department to the position of assistant engineer in the office of the engineer of rolling stock. In March, 1923, Mr. Kiefer was promoted to assistant engineer of rolling stock and in May, 1924, he was promoted to engineer of motive power of the Lines East and West. In January, 1925, he was promoted to engineer of rolling stock, which position he held until his recent appointment as chief engineer of motive power and rolling stock.

Master Mechanics and Road Foremen

IRVING C. BLODGETT has been appointed road foreman of engines of the Boston & Maine, with headquarters located at Boston, Mass.

W. F. SHELLY has been appointed road foreman of engines of the Jacksonville district of the Atlantic Coast Line, with headquarters at Sanford, Fla.

P. H. MILTON has been appointed road foreman of engines of the Gainesville district of the Atlantic Coast Line, with headquarters at High Springs, Fla.

Shop and Enginehouse

R. J. BURSEY, air and rod gang foreman of the Chesapeake & Ohio at Clifton Forge, Va., has been promoted to assistant general foreman.

F. G. HUTCHINSON, lead man in the boiler shop of the Atlantic Coast Line at Waycross, Ga., has been promoted to gang foreman, in charge of all tender repairs, including the repair of frames and trucks.

Car Department

R. S. DICKERSON, assistant gang foreman of the car department of the Chesapeake & Ohio at Fulton, Va., has been promoted to gang foreman.

EARL BENDLE, gang foreman in the car department of the Chesapeake & Ohio, has been promoted to lubrication inspector, working from Handley, W. Va., east.

Obituary

H. B. HENRY, assistant to the general purchasing agent of the Southern Pacific, with headquarters at San Francisco, Cal., died on December 21. Mr. Henry had been in the service of the company for about 30 years.

Railway Mechanical Engineer

Volume 100 MARCH, 1926 No. 3

Table of Contents

NEXT MONTH

Operation of the new Juniata locomotive repair shop of the Pennsylvania

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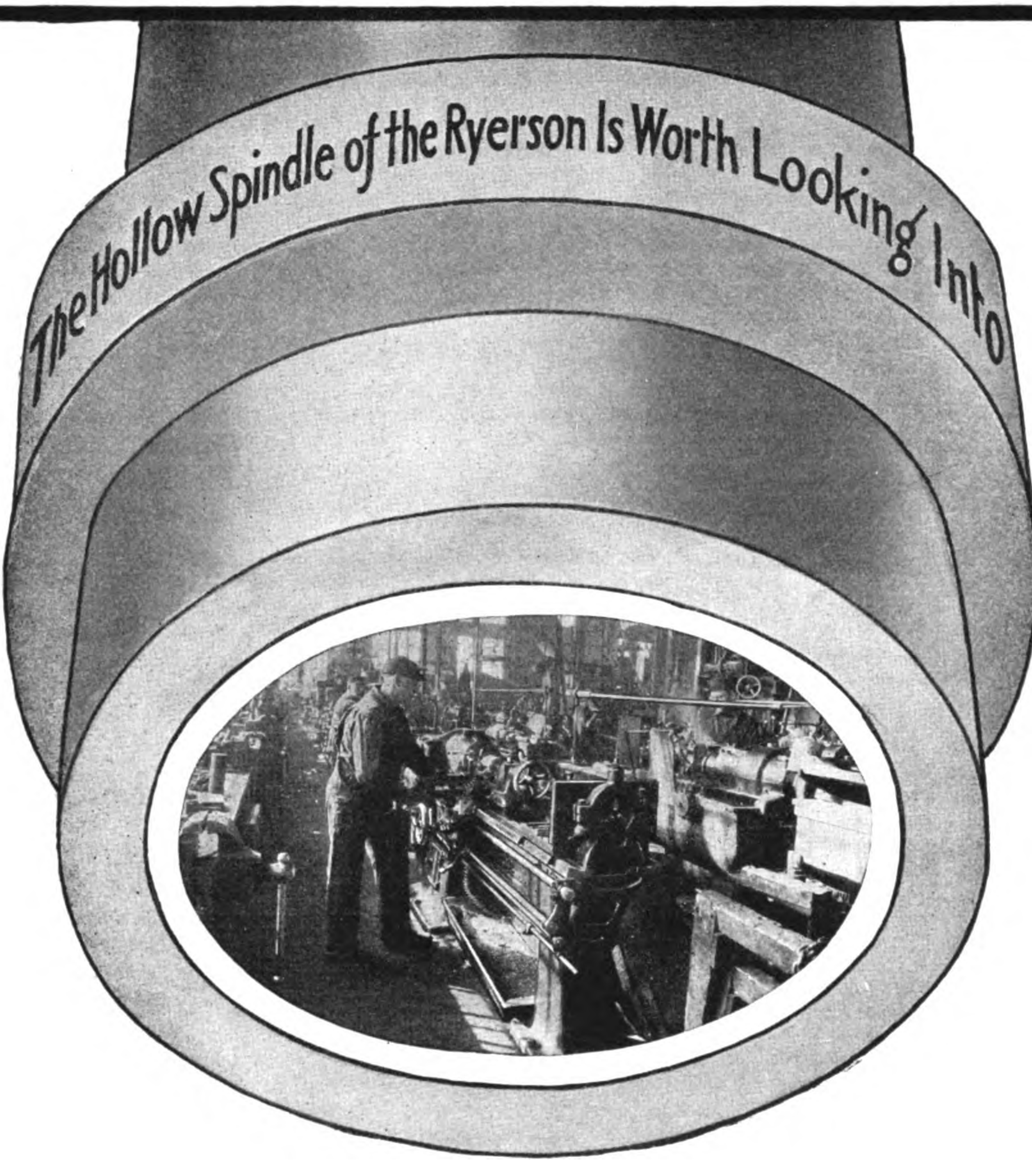

Mechanics Fight For—Ryerson Lathes

THIS photograph shows a typical railroad shop on an Eastern Line. One of the features that makes this shop typical of railroads is the Ryerson-Conradson Engine Lathe which is used for turning wrist pins and link motion parts for locomotives. You'll find R-C Lathes in most of the railroad shops; in fact, on a Western Line a mechanic insisted upon running the R-C Lathe that had just been installed there, and he put forth his claim of seniority as a reason why *he* should run the R-C. The qualities in a R-C Lathe that make the workmen fight for a chance to run it are the very reasons why you should look into this lathe.

Heavy chips; no chatter, and low upkeep cost.

Write for Bulletin 1301

JOSEPH T. RYERSON & SON INC.

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Railway Mechanical Engineer

Vol. 100 March, 1926 No. 3

Carelessness in locomotive lubrication

In adjusting the cylinder lubricator feeds, how many enginemen count the drops of oil for a full minute? Instead the drops are counted for 15 or 30 sec. with the result, that owing to slight variations in the viscosity, either too much oil or not enough is fed to the cylinders. In the case of the former condition, an excess of oil enters the cylinders which eventually forms a heavy carbon residue that builds up behind the packing rings and eventually causes the rings to seize in the ring grooves and become inoperative, resulting in a great loss of power. Furthermore, the oil is wasted at the beginning of the run with the result that little or no oil is available for the latter part of the run. In the case of not enough oil, the cylinder and valve chamber walls are cut or scored which causes a loss of power to say nothing of the increase in maintenance costs. The attention of the enginemen might well be called to the fact that there are 60 seconds in a minute. To oil the driving rods, truck boxes, valve motion parts, etc., the engineman is supplied with a certain amount of engine oil. That it is not all used for this purpose is evident from the stream of oil on motion work and ground by which the path of some enginemen may be traced around their locomotives. This practice is not only an avoidable waste but defeats the ends for which the oil is intended and thus is conducive to increased friction which requires more fuel and more maintenance. These factors may seem unimportant but they are among the many little things which, added up, make the total a good or a poor job of railroading.

Mechanical efficiency in operating index

In an address before the January meeting of the New England Railroad Club, W. J. Cunningham, professor of transportation, Graduate School of Business Administration, Harvard University, gave a highly enlightening exposition of the way in which railway operating efficiency is reflected by the figures for gross ton-miles per train hour. These figures, containing as they do both train load and time factors, primarily measure the efficiency of train crews, dispatchers, operators, yardmasters and others having to do with train service. They also reflect, however, the efficiency of practically the entire railroad machine and are vitally affected by the condition of car and locomotive equipment, for example. The mechanical department has an important part to play in gross ton-miles per train hour performance and can perform this part only by keeping each class of car in good condition for handling the commodity for which it was designed and furnishing motive power adequate in amount and condition to handle trains over the road with the minimum interruption of service due to failures or other causes.

A railroad, referred to in Professor Cunningham's paper, was able to make a marked improvement (32.5 per cent in 12 months) in gross ton-miles per train hour performance by purchasing new locomotives, making enginehouse improvements, rearranging yard tracks and sidings, and in particular by an intensive campaign to enlist the sympathy and support of the employees in an improved showing for their road. Charts were broadcasted weekly giving the performance as compared to the same week in the preceding year and the goal was gradually raised from 11,000 to 12,000 and then 13,000 gross ton-miles per train hour. The results of this campaign were plainly evident not only in improved operation, but reduced mechanical department costs. While freight locomotive and train miles in a given period decreased about 11 per cent over the same period in the preceding year, the number of cars per train increased 16.2 per cent; train speeds, 14.9 miles per hour; and car miles per car day, 30.5 per cent. On a thousand gross ton-miles basis, fuel consumption decreased 26.5 per cent, locomotive repairs, 28.7 per cent, locomotive supplies other than fuel, 10 per cent, and enginehouse expenses, 44.7 per cent. In other words, the mechanical men on this road by lending their assistance to the achievement of an operating goal made a splendid showing for themselves.

The value of keeping a single objective constantly in view was demonstrated in the case mentioned above which proved that while railroad mechanical departments are primarily engaged in maintenance and conditioning work, their efforts have a vital influence on railroad operation as a whole and on performance records often thought of as entirely operating in character. The sooner mechanical department officers realize these facts and broaden their interest in and knowledge of operating matters, the sooner will they be adequately represented among the ranks of higher railroad executive officers.

Making foremen's clubs more effective

The development of foremen's clubs and training classes in the mechanical departments of the railroads has received a remarkable impetus this season. Many different schemes are being tried, extending all the way from classes in foremanship and leadership under the general direction of the extension departments of state universities, to supervisors' clubs with various sorts of programs. There is always, of course, a certain amount of help and inspiration by bringing in someone from the outside who has had a special opportunity of studying or experimenting with foremanship, salesmanship or management problems. On the other hand, the club members get out of the meetings largely in proportion to the extent to which they contribute to or take part in them. Giving expression to one's ideas helps to stimulate thinking and to crystallize ideas.

The great difficulty is to find leaders who have the

ability or experience to conduct discussions in such a way that the club members will participate freely. We are constantly being asked for suggestions as to where or how group or discussion leaders can be found or developed. As a matter of fact, the successful conducting of such discussions is something of an art. It requires a man first of all with the right sort of personality and then some special training or experience. Fortunately this need has been recognized by a number of those who have been particularly interested in promoting foremanship training, and last summer several conferences were set up under different auspices to give prospective conference leaders an intensive training.

The foremanship training class held under the direction of the Y. M. C. A. at Albany and including foremen and supervisors from the Delaware & Hudson and the New York Central, as well as from the industries, sent three men last summer to attend one of these conferences for training discussion leaders, which was held under the auspices of the Industrial Department of the Y. M. C. A. at Silver Bay. As a result, the last two meetings of the club, which have been unusually successful, have included a simple supper, some music, a talk from an outside expert or authority, and then a lively discussion of the responsibilities and duties of supervisors. The leader in a skilful way has refrained from answering questions or expressing opinions, but has drawn the crowd out as to their experiences and opinions, pro and con. Under the direction of the leader one of the class members has officiated at a large blackboard; the high points of the discussion are noted and are thus convenient for ready reference during the discussion. It is a little bit difficult to get discussions of this sort started and under way, but soon enough interest is inspired so that the members generally enter into the discussion and debate with considerable enthusiasm and eagerness. The chances are that the discussion will be extended over into smaller groups for several days following the meeting. Does not this promise the best sort of practical results and is it not something toward which all of the foremanship clubs and classes should aspire?

A "slow order" on shop scheduling

About ten or fifteen years ago the "efficiency expert" enjoyed a much greater degree of popularity than he does today. This is not because the demand for efficiency has decreased, but probably because of the abuse of the prestige that the title enjoyed at that time. The efficiency engineer of that period laid the foundation for many ideas which have resulted in the remarkable development of modern industry. In certain fields of endeavor, notably that of the automotive industry, the application of the principles of scientific management has made possible the quantity production which has been a big factor in its rapid development. It will be remembered by many present-day railroad officers that several of the larger roads of this country engaged the services of efficiency experts to study railroad shop operating conditions and submit recommendations for improvements in practice. It may also be recalled that unfortunately many of these recommendations proved impractical. This was not necessarily any reflection on the initiative and ability of the men who made the recommendations but was due possibly to a lack of understanding on their part of the conditions surrounding the industry they were trying to serve.

The railroads at that time had not yet been faced with the urgent need of increased efficiency such as exists today. Neither had the automobile industry been developed to its present-day stage wherein it could have served as a concrete example of the value of scientific management. In short, the efficiency engineer of 1910 was forced to sell his idea to the railroads on theory alone in the face of a "market" which lacked the element of demand.

There is a present-day demand for increased railroad shop efficiency that is equally as marked as the demand for industrial plant efficiency. The effort to meet this demand has led many railroad shops to install scheduling systems. Some of these have served their purposes remarkably well while others have failed and, in failing, left those who have tried them doubly skeptical as to the value of any scheduling system.

In an endeavor of any kind an impartial analysis of the causes of failure may prove far more valuable than a study of successful methods if for no other reason than that attendant conditions must of necessity be taken into consideration. Is it not possible that some present-day shop supervisors fail in their efforts to install "efficiency" systems for the same reason that the efficiency engineer of 1910 failed—because each lacks a thorough knowledge of the principles of the other's business?

Modern industry profits by the efforts of thoroughly trained industrial engineers. The most successful of these men are those trained first, in the fundamental principles of industrial management and second, in a thorough knowledge of the conditions surrounding the industry they strive to serve. What systematic efforts are the railroads making to train their own "industrial engineers"?

Shop schedule systems may either contribute to a reduction in maintenance of equipment expenses or become a source of loss, depending on the intelligence used in their application. Shop scheduling is attracting widespread attention among railroad shop men and now is the time, before too many costly errors are made, to train men specially for this field of railroad shop work. It is neither necessary nor desirable for a shop superintendent or general foreman to add to his already arduous duties the responsibility of developing a scheduling system. Some of the money occasionally wasted in cut-and-dry methods might more profitable be expended in the training of one man or a group of men—first, in the principles of shop management, and second, in the conditions under which their own and other similiar shops must operate. This having been done, all that is needed is the whole-hearted backing of the officer who has the proper authority, to get results without wasted effort.

A Finish Fight!

Almost twenty-one years ago George M. Basford made his remarkable address on "The Technical Education of Railroad Employees—The Men of the Future," before the American Railway Master Mechanics' Association. Mechanical department officers on two roads at least, caught its full significance and started actively to install modern apprenticeship systems, in line with Mr. Basford's suggestions. John Purcell on the Santa Fe had always taken a deep interest in the welfare and progress of apprentices. Frank Thomas, engineer of tests on the Santa Fe, with a splendid technical training and a big heart, was assigned the task, under the direction of Mr. Purcell, of developing and applying the methods suggested by Mr. Basford. J. F. Deems, general superintendent motive power of the New York Central Lines, called Mr. Basford into consultation and together they worked out a plan to meet the needs of the apprentices on that system. It will be recalled that the roads forming the New York Central Lines were not as closely associated as they are today and considerable diplomacy and tact were required to extend

the new apprenticeship methods to all of them. C. W. Cross, master mechanic on the Lake Shore & Michigan Southern at Elkhart, Ind., like Mr. Purcell on the Santa Fe, had shown unusual interest in the apprentices; moreover, he was widely acquainted with the mechanical department officers of the New York Central Lines and was possessed of considerable diplomacy. He was chosen to head up the apprenticeship work on the system, and selected as his associate an educator, Walter B. Russell, now director of Franklin Union, Boston, Mass., to develop the school work courses.

Mr. Basford when he made his address in June, 1905, was editor of the American Engineer and Railroad Journal, now the *Railway Mechanical Engineer.* A few months later he gave up editorial work and became associated with the American Locomotive Company. During the remainder of his life, however, he continued to be an enthusiastic promotor of modern apprenticeship methods.

In 1908 a committee on apprenticeship recommended to the American Railway Master Mechanics' Association a number of basic principles which it believed to be vital to the success of an apprentice system. This report was adopted and these principles today stand as recommended practice of the Mechanical Division of the American Railway Association.

The American Engineer and Railroad Journal and its successor, the *Railway Mechanical Engineer,* have continued to advocate more or less aggressively during the past twenty years that greater attention be given to the training of shop apprentices. During these twenty years they have presented some noteworthy contributions to the literature on this subject. The progress of apprenticeship on the railroads has been followed closely. In 1907, for instance, a series of articles was published covering the details of apprenticeship methods on the New York Central Lines which attracted widespread attention. Articles have been published at various times covering the proceedings of the apprentice instructors' annual conferences on both the New York Central and the Santa Fe. A series of articles covering the apprenticeship work on the Santa Fe, after long years of experiment and development, was published in the *Railway Mechanical Engineer* in 1924. Two competitions, one for the regular apprentices and another for the special apprentices, were held in 1923, in which an attempt was made to have the young men, themselves, tell what they thought about apprenticeship and its shortcomings, and how the methods and practices could be improved. Our expectations were more than fulfilled in the type of material submitted in these competitions and the result was the demonstration of a greater interest in apprenticeship on several different railroads.

The conditions in the railroad shops during the war and post-war periods and the shop strike in 1922, rather seriously complicated the situation so far as apprentice training was concerned. After the strike several of the roads started to take a greater interest in the apprentices, and a number of them made a study of conditions on the Santa Fe and adopted its methods, at least in part. The work which was so well started on the New York Central and which continued in a large way for a number of years, slumped off to some extent even before the war, but fortunately it was so strongly intrenched that the local shops carried it on with more or less success, although without much overhead supervision. More attention has been given in recent years to apprenticeship, however, on the basis of the system as a whole.

One result of the tendency to recognize more and more the importance of the human element in railroading, has been to focus greater attention upon the problem of leadership and the necessity of paying more attention to providing better workers for the future. The past few years have, for instance, seen the development of a large number of foremen's clubs or foremanship and leadership training classes. The *Railway Mechanical Engineer* has had an important part in this development, culminating in the rather heated controversy during the past year between the adherents of "Bill Brown" and "Top Sergeant."

We have been trying to find some way of focusing similar attention upon the need for preparing better workers for the future, and the first gun is being fired in this issue. One shot is in a communication on the Readers' Page, in which the writer comments upon the shortcomings of some of the apprentice systems. The second shot is an article by C. Y. Thomas, supervisor of apprentices of the Kansas City Southern, in which he suggests why it is that there has not been a more rapid extension of modern apprenticeship methods. He also makes a constructive suggestion for a remedy. C. Y. Thomas is one of the younger group of apprentice supervisors and is a son of Frank Thomas, of the Santa Fe.

Without realizing that we were starting this campaign, two other of the younger apprentice supervisors have furnished us with articles which will be published in our April and May issues. All three of these young men are making a decided success of their work. All three have studied modern apprenticeship methods thoroughly and have been seeking to find ways and means of making their methods and practices more effective. Each one of these men has given us his best thought without any reference to the others or knowledge that they were to contribute.

Our whole aim has been to present the most constructive material that we could discover on apprenticeship methods, with an idea of stimulating greater interest in apprenticeship. We hope that our readers will discuss this entire question with extreme frankness. We shall be disappointed if not one, but several "Top Sergeants" do not bob up and challenge the practices on the different railroads or what the contributors have to say. There are undoubtedly some who question the value of apprenticeship at all. We hope that they will feel free to take issue with us. Now, if ever, is the time to go to bat on this question and clear it up. Twenty years of trial are surely enough to have demonstrated beyond a question of doubt the advantages or disadvantages of modern apprenticeship methods. What are the railroads going to do about it?

Improving the locomotive

Few important innovations in the construction or functioning of the steam locomotive have been brought forth full fledged. The limitations of space and weight so restrict the design, and the effects of the highly variable conditions under which the locomotive must operate are to so large an extent evaluated on a wholly empirical basis—where they can be evaluated at all—that the most experienced opinion as to the consequences of any major departure from the well beaten path must contain many speculative elements. What on paper is a wholely plausible project for a highly desirable locomotive improvement raises many questions which can be satisfactorily answered only by construction and then by operation and maintenance under conditions of every-day railroad service. The chances are very great that success will not crown the first effort and that another trial—perhaps several retrials—will be necessary before the changed construction, whatever it may be, has been

adapted in all its details to meet the requirements and withstand the abuses of railway service. The process is a slow and painful one and it is not surprising that railway officers, particularly those in the mechanical department, have acquired their reputation for great conservatism.

The first requirement of a railroad organization is to provide transportation service with whatever tools are available under the existing state of the art. The development of inventions must be a secondary matter. Furthermore it is a highly speculative occupation. Under existing public regulation the reward of success is not always sufficient to justify risking the losses of failure.

Progress, however, can not be obtained without the assumption of some risk on the part of individual railroads and railroad officers. This is true even where the greatest risk is assumed by private enterprise, outside of the railroad organization, because without the support of a railroad in furnishing the field for practical development, the best organized private enterprise can do nothing. The need, however, is not so much for greater liberality in offering opportunities for initial tests as it is for greater courage in following a development, once started, through to conclusion. Many valuable ideas have either been lost or their ultimate development delayed for years because of a lack of discrimination between inherent difficulties and mere weaknesses of form or arrangement possible of correction. The officer who is sufficiently convinced of the value of an idea to give it an initial trial, but who is not prepared to face several repetitions of the original trial, in none of which complete success may be obtained, is rendering no real service to progress. Only those who have the courage of their original convictions and the patience to withstand the disappointments of development should become a party to the original installation and trial.

A typical instance of the laborious nature of the process of developing locomotive improvements will be found in the case of the McClellon water-tube firebox, carried out on the New York, New Haven & Hartford, and a description of which will be found on another page of this issue. After a wait of ten years, the full practicability of this type of firebox construction seems now to be established. During this decade there was the usual sequence of initial failure, painstaking development and reconstruction to provide for the effect of conditions which at the outset were either entirely overlooked, or at least greatly underestimated, then years of service to see what further unexpected difficulties of maintenance might develop, and finally after a redesign to eliminate the patch work necessarily a part of the development stage and to take advantage of improvements in other directions made possible by this type of construction, there were tests to measure its value as an operating factor. The operating and maintenance results are ample justification for the persistence with which the development has been seen through to its conclusion. Nothing but loss would have resulted had the initial lack of success been interpreted as final.

Most of the improvements in the steam locomotive during the past quarter of a century have essentially involved no changes in the locomotive itself, but have largely constituted additions to the locomotive. Recent developments suggest that we are entering a new era of locomotive development in which many proposals will be brought forward involving marked changes in the locomotive itself, such for instance, as the four-wheel trailer and the McClellon firebox itself. The growing appreciation of the economic posibilities of high steam pressures may be cited to indicate the direction in which some of these changes may tend. The water-tube firebox, such as that just referred to and that developed by John Muhlfeld for the "Horatio Allen," have removed the present firebox limitation on boiler pressure, but no great advance in pressure can be made without some substitute for the present firetube barrel portion of the boiler.

If such possibilities as that suggested by high steam pressure are ever accomplished, it will be only because some railroad and its officers are willing to lend constructive aid in the development of what may be major modifications in construction when proposals promising practical results are brought forward. No matter who may take the major risk and reap the major reward, a very great and very definite responsibility for progress in locomotive development rests squarely on the shoulders of railway officers.

New Books

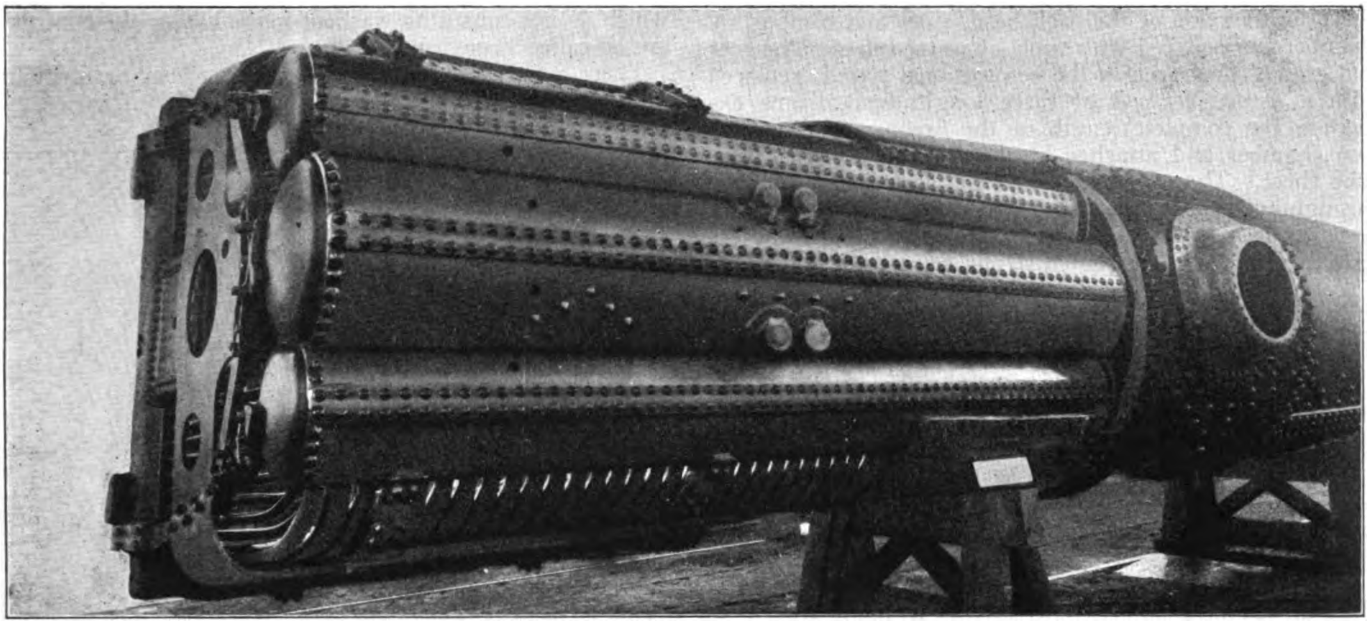
Draft and Capacity of Chimneys. *By J. G. Mingle, Civil Engineer, 344 pages, illustrated, 5¼ in. by 8 in. Price* $3.50. *Published by D. Van Nostrand Company, 8 Warren Street, New York.*

In developing the theory of draft and capacity, the author has dissociated the two entirely; that is he has assumed that the height of the chimney is dependent only on the draft requirements and the diameter only on the capacity requirements, although each has a secondary influence on the other. This means of organization will particularly appeal to the designer of power plants who is desirous of investigating all of the conditions to which his contemplated chimney may be subjected as well as to the operator of power plants who must check the size of his existing chimney with the view of eliminating draft and capacity shortcomings. The work is carefully illustrated with graphs and diagrams.

There are fourteen chapters. In them the author has developed his theoretical data simply and directly and has amplified it with experimental information on performance and thus developed a series of practical hints which will aid materially in the proper construction of chimneys.

Tool Foremen's Proceedings.—*Edited by G. G. Macina, secretary, 11402 Calumet Avenue, Chicago, and published by the American Railway Tool Foremen's Association. Imitation Leather, semi-flexible binding, 178 pages, 5 in. by 9 in., price* $2.50

This book contains the proceedings of the thirteenth annual convention of the American Railway Tool Foremen's Association and in a number of respects is a marked improvement over any volume previously issued. The proceedings have been carefully edited to eliminate a large proportion of the more or less extraneous discussion, and as a result it is relatively easy to follow the trend of the discussion as well as the conclusions reached. Particularly valuable information on machine tool equipment for toolrooms of various size is included, as well as reports of various standing committees which have been assigned important topics. Special interest also attaches to the report of the Committee on Standardization which offered definite recommendations for standard locomotive rod and frame reamers subsequently adopted by the association. In addition, the volume contains drawings and photographs of a considerable number of labor-saving shop jigs and devices. The table of contents enables any of the reports to be located quickly and a general index in the back of the book affords ready means for locating the remarks made by individual members. Every tool foreman should possess one of these volumes to keep in touch with the work of his association, and the present volume would be a good one with which to start a file because it is the first to have this particular type of binding with the initials of the association and year shown on the backbone.



Top of the firebox and combustion chamber—Note the heavy plate cross-member on the back head

McClellon water-tube boiler shows good results

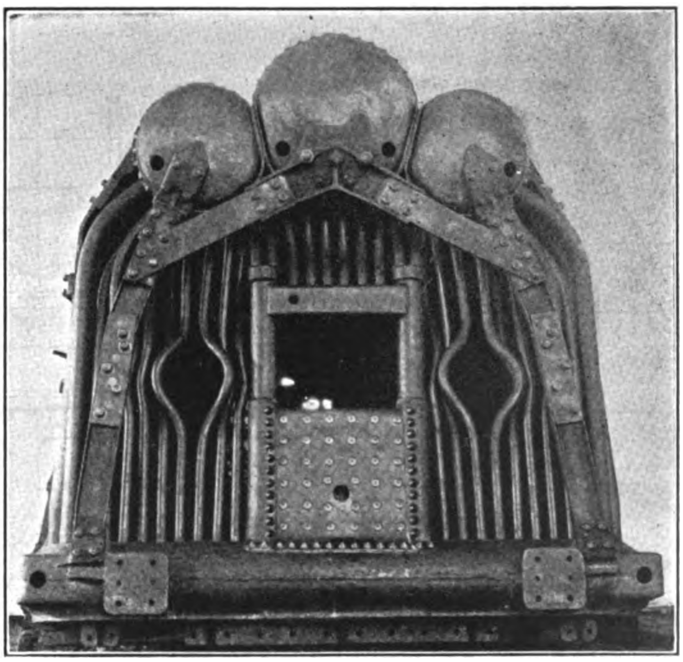
Developed on New Haven, the locomotive shows improved thermal efficiency and greater capacity

IN 1916 the New York, New Haven & Hartford, placed in service two Mikado type locomotives fitted with McClellon water-tube fireboxes, of the type for which a patent was granted to the late James M. McClellon, and is now owned by the McClellon Boiler Company, Boston, Mass. These two boilers met with indifferent success. The original design developed some weaknesses in the details of its construction but showed that its fundamental principles were mechanically sound and that with a modification of the details that were giving trouble, the boiler would probably give satisfactory service. Unfortunately, Mr. McClellon died at this time, just as the boiler had demonstrated its possible practicability.

W. L. Bean, mechanical manager of the New York, New Haven & Hartford, feeling confident that this type of firebox construction possessed advantages over the ordinary radial-stayed firebox, undertook to study fully and to correct the troublesome features which had become apparent in actual service. These changes were made in 1920 to the two original boilers, which are still in service. In 1924, having 10 mountain type locomotives on order with the American Locomotive Company, it was decided to equip one of these locomotives with the McClellon firebox, embodying such changes in the structural design as had already been made in the two existing boilers, and including further modifications which were felt might prove to be advantageous.

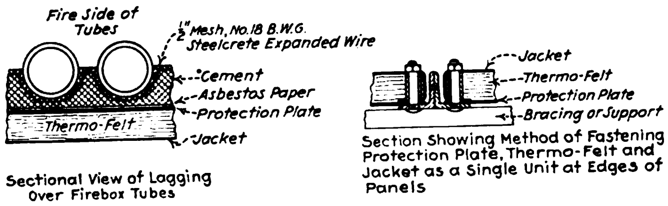
Realizing that this design of boiler is particularly adaptable to high pressures, one of the modifications made in the new locomotive was to increase the boiler pressure to 250 lb., which, with the use of a 70 per cent limited cut-off, would give greater steam economy. Viewed from the standpoint of the present design, it is of very simple construction and well adapted to meet and properly withstand the stresses inherent in locomotive service.

The character of the construction is clearly shown in the illustrations. It will be seen that the ordinary parallel



The construction of the back boiler head—Note the pads on the channel braces to which the heavy plate cross member is bolted

sheet construction of the back head, sides and combustion chamber are replaced with walls of water tubes. The roof and crown sheet area in the conventional type is replaced with a section formed of three longitudinal drums extending the complete length of the firebox and combustion chamber and attached at the front end to the rear tube sheet. These drums are in contact with each other throughout their length and are so flattened at the contact areas as to permit the largest possible steam and water space. They are prevented from separating by screw



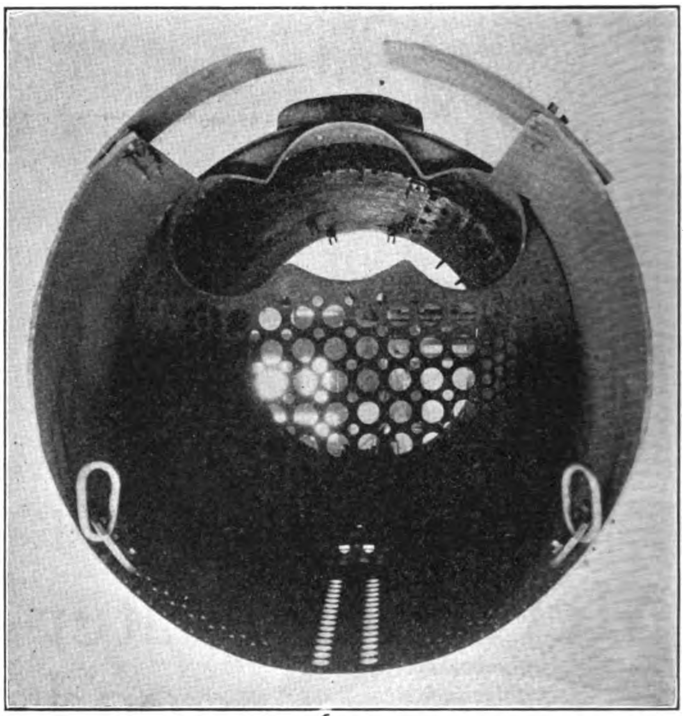
Details showing the construction of the firebox enclosing wall and the method of attaching the lagging and jacket in panel units, to a framework of angles supported on the firebox braces—The usual type of asbestos lagging and jacket are applied over the top and ends of the drums

rivets that keep the flat sections in continuous contact throughout.

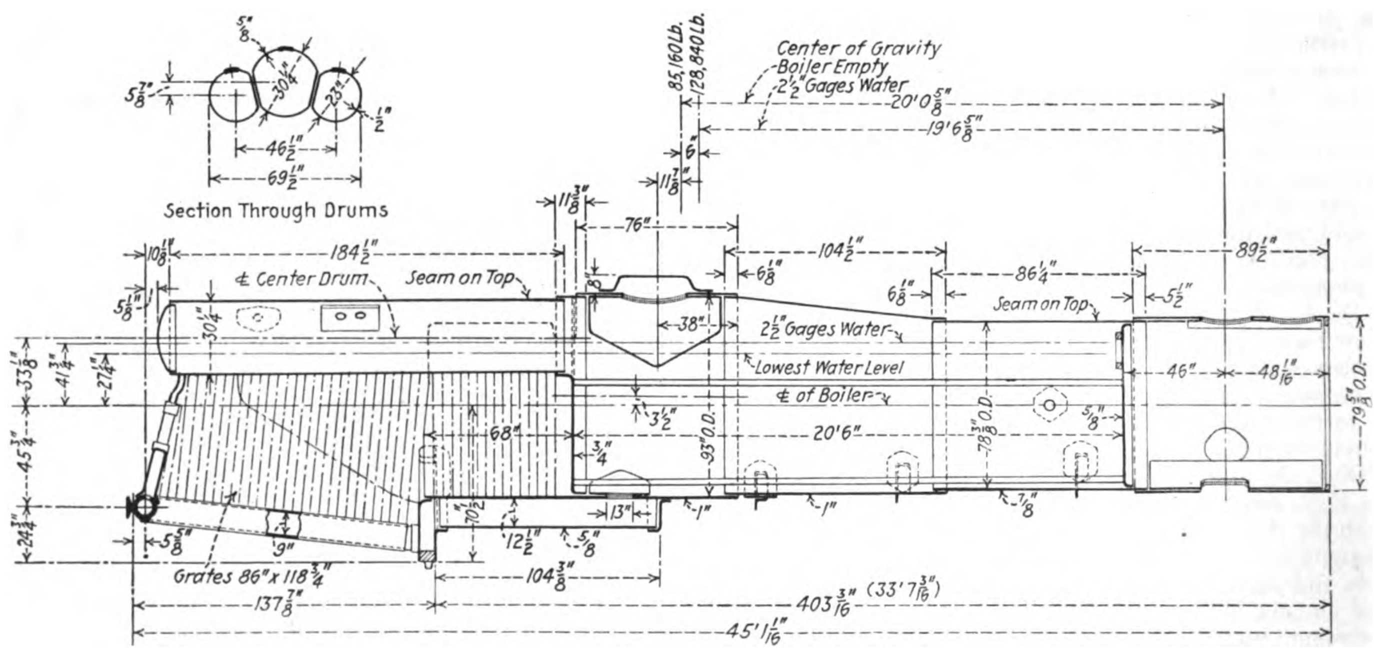
Combustion chamber and side tubes are 4 in. in outside diameter, swedged to 3 in. at the ends, with walls 1/4 in. thick. The back head tubes are 2 in. in outside diameter for their entire length, with walls 3/16 in. thick. All tubes are rolled and beaded at the top ends in the drums, but are rolled and flared in the mudring at the bottom ends. The arch tubes are conventional in size but at the top the ends are turned up into the drums and rolled and beaded. All tubes entering the drums are on the drum radius and perpendicular at the point of entrance.

To accommodate proper seating of the tubes in the mudring, the top wall is flattened inside and outside. The outside of the bottom wall also is flattened. Through it holes are tapped opposite each tube to permit the initial installation of tubes and such inspection and maintenance as may be necessary. These holes are closed with plugs, all of which do not constitute washout plugs but on the contrary are so-called "construction plugs."

There is a slight clearance between all tubes forming the firebox construction in order to permit of easier installation. Lagging and protection is applied on the sides and back head, outside of the tubes, to which reference will be made later. All back head tubes are staggered at the entrance into the drums because of the relatively restricted section forming the crown, as compared with the length for tube spacing available in the mudring.



Interior of the combustion chamber dry shell, showing the opening in the tube sheet for the firebox drums

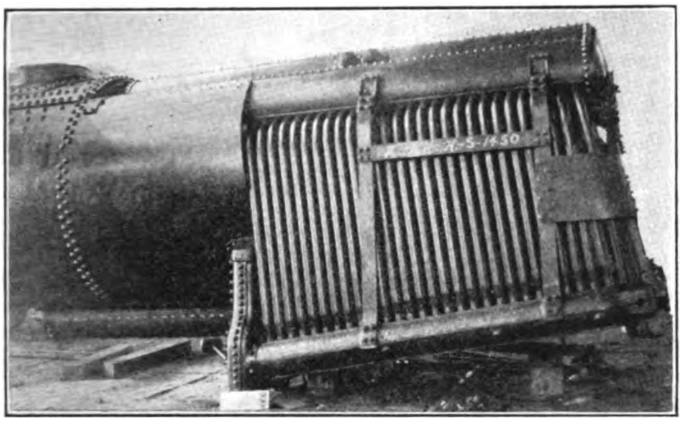


Sectional elevation of the McClellon firebox and boiler

The illustrations given are all taken from locomotive 3500, which is equipped with a Duplex stoker. Several of the back head tubes are bent away from their normal posi-

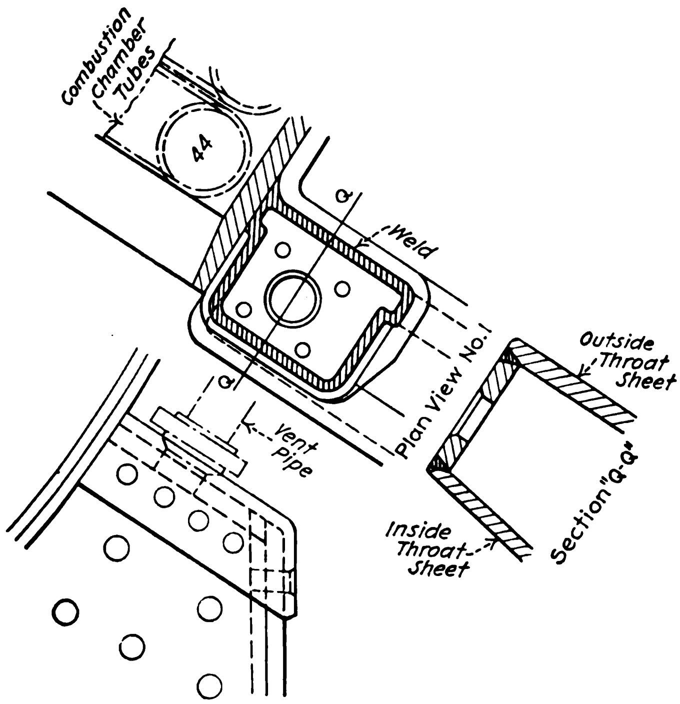
tion in order to permit entrance of the stoker distributor tubes. This construction is used where the Duplex stoker is applied but is not used when the Standard stoker or similar types are applied.

The fire door opening is a combination water-leg and water-tube construction. The section below the door is of a conventional stayed construction. It is made up in three



Side of the completed firebox

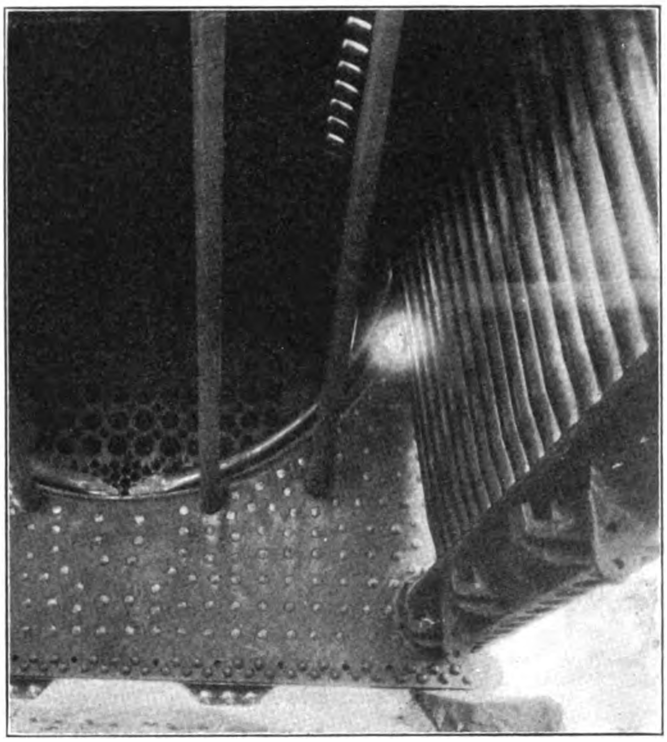
pieces: a single inverted U-shaped piece flanged and riveted to the mudring, with the ends closed by semi-circular sheets bent and riveted in place. The sides of the door opening are formed by large tubes joining the stayed section at the bottom and connected near their upper ends by the top door member which is formed rectangular in



Method of closing throat sheet corners—A plate is first welded in the opening, the lap of the sheets at the end of the throat is smoothed by welding and scarfing, and the flanged cap fitted in place hot, after which it is secured by screw rivets and welded to the dry shell and to the inside plate at the edges of the vent opening—The opening is then reamed and the studs applied

section from round tubing. Regular 2-in. tubes are carried from the top member of the door frame up to the drums in the same manner as the main back head tubes, with plugs located on the underside of the rectangular member opposite tube holes. The large side tubes are capped at their top ends with steel castings, welded in place, into each of which two 2-in. tubes are applied and carried up to the drums.

One of the troubles with the original construction was lack of provision for any column action to take the stresses between mudring and drums independently of the tubes. This situation is avoided by a series of braces between the mudring and the drums so arranged as to form, in combination with the drums and mudring, a hollow box girder type construction. This relieves the tubes of any duty other than that of steam and water containers under pressure. Shocks incident to locomotive service are transmitted through this bracing construction and kept away from the tubes, so that they remain continuously tight, even under severe and unusual operating conditions. The braces at the sides of the firebox are of channel section secured with fitted bolts to the mudring and to castings applied to the drums. The braces are seated against



Interior of the firebox before the walls were closed

shoulders so that the bolts are relieved of shear. Horizontal members of rectangular section connect the main side braces to give additional stiffness.

The arrangement of bracing, being free from triangulation, permits the necessary free longitudinal movement of drums relative to the mudring resulting from temperature differences between the mudring and crown sheet areas. Similar construction is employed at the back head. The top connections of the back head braces into the saddle castings on the drum heads are so arranged as to permit inspection and attention to the seams between drums and drum heads. An arch effect is obtained through the use of the diagonal braces which connect the column members to the center drum.

A back head belt of wide plate section is bolted to the back head braces and carried around the corners of the firebox to the rear side braces. This not only forms a part of the back head bracing, but serves as a foundation on which all of the back head and cab fittings are applied.

The throat sheet at the front end of the firebox is generally similar to the ordinary throat sheet in com-

ventional boilers, except that it is vertical and is arranged to give greater accessibility for washing out. The back plate of the throat is flanged outwardly to receive the front ends of the hollow mudring, and opposite the mudring connections, the front throat sheet is fitted with hand hole plates similar in construction and arrangement to those used in marine and stationary practice. The top points at the sides of the throat are fitted with caps and vented through copper pipes which permit the escape of steam into the steam space in the central drum. One of the drawings shows a detail of this construction.

The combustion chamber, like the firebox, is of water-tube construction, but it is encased in a dry shell extension of the third barrel course. This course provides the structural strength for the connection of the firebox and the barrel portions of the boiler. It will be seen in the photographs that at the top it is securely riveted to the two outside drums throughout the length of the combustion chamber and that the inside and outside throat sheets are riveted to it at the bottom. The rear tube sheet is also riveted in this course with the flange extending forward into the water space. It is flanged in the opposite direction to receive the front ends of the three drums which form the top of the firebox, no flanging or swedging of the drums being required. To permit the caulking of the tube sheet flanges at the sides of the two outside drums where the dry shell overlaps the flanges, a recess has been cut in this shell. The opening thus made into the combustion chamber is closed with a fitted cover plate, to prevent the escape of gases into the lagging.

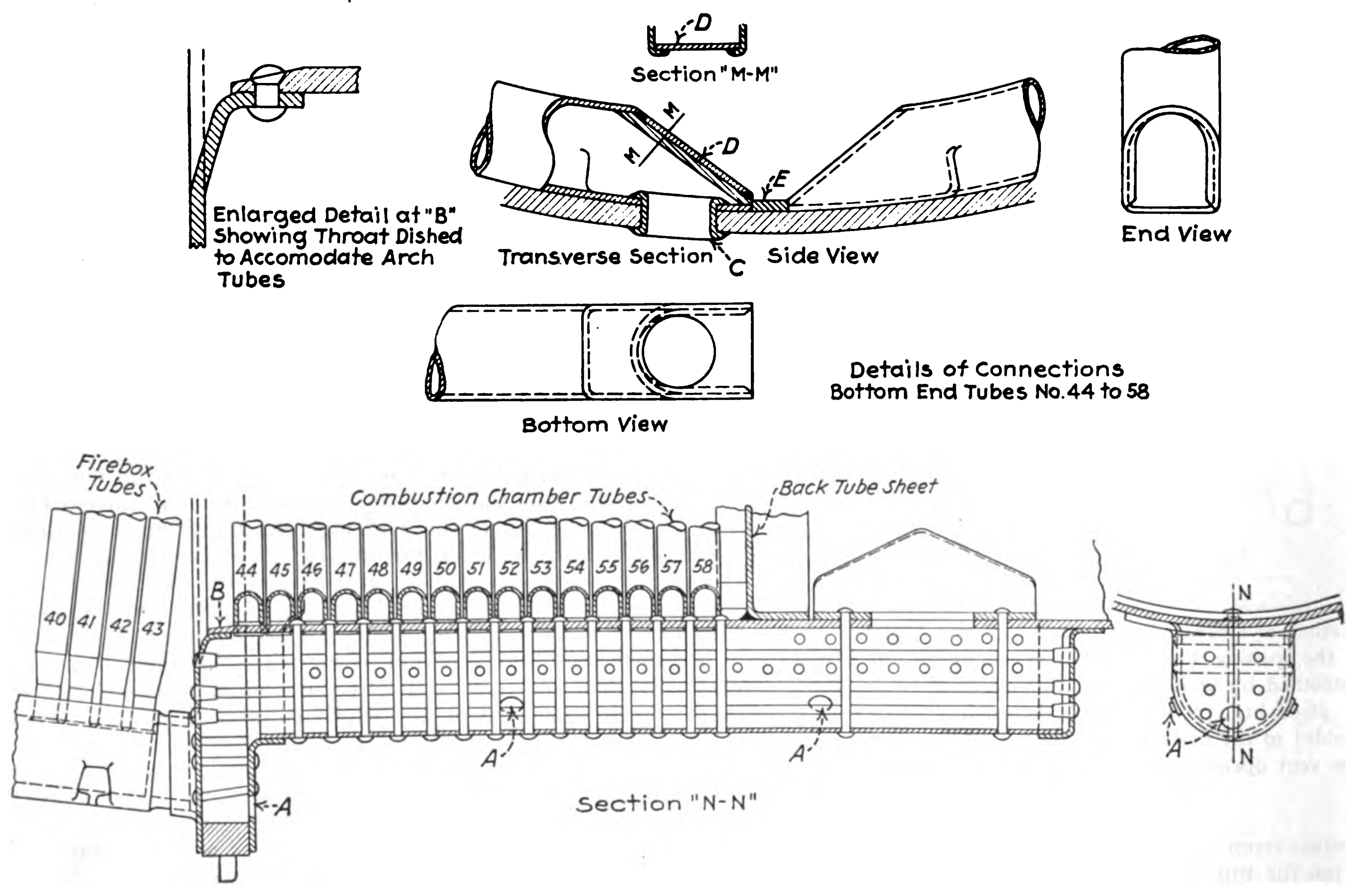
To permit the transfer of water from the barrel of the boiler to the firebox and combustion chamber a circulating trough is riveted on the outside of the third course at the bottom. The front end extends ahead of the tube sheet and opens through the shell into the boiler, while the rear end is riveted into a flanged opening in the outside throat sheet.

All combustion chamber tubes enter the side drums at their upper ends in line with the firebox tubes. The bottom ends of all except the rear tube on each side open to the

The firebox walls closed, ready for the lagging and jacket

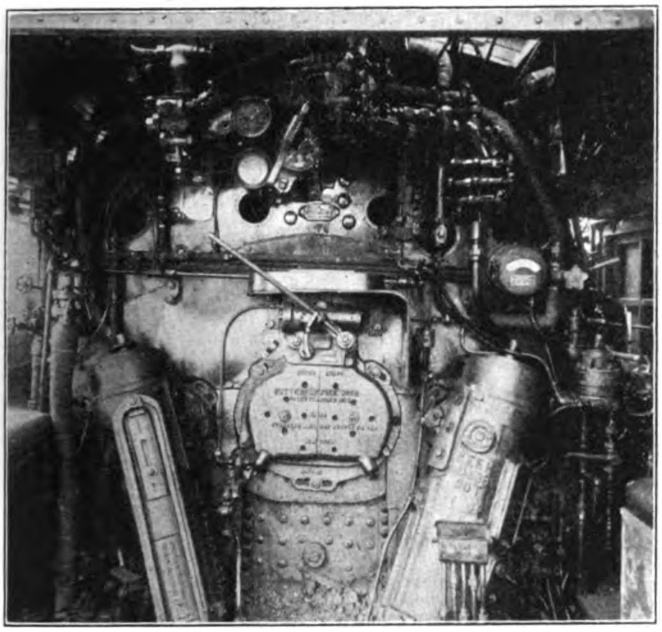
circulating trough through holes in the dry shell. The rear tubes open directly into the throat sheet water space.

The attachment of the combustion chamber tubes to the circulating trough involves a unique type of construction.



Circulating trough and combustion chamber tube construction—Washout plugs as shown at A; circulating nipple at C; combustion chamber tube end at D, and space block to relieve nipples of shearing, at E

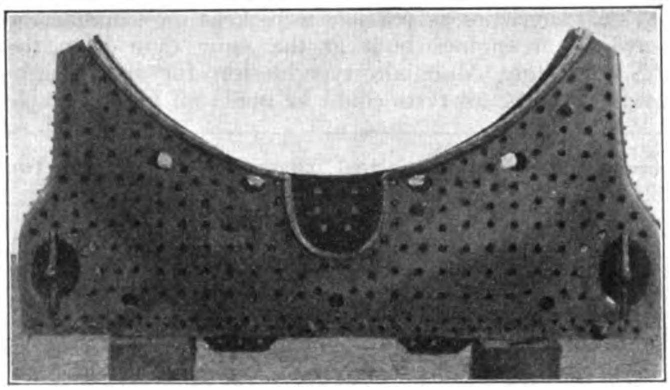
which is shown in detail in one of the drawings. The tubes are flattened and curved to fit the dry shell at the bottom and their ends are cut away on an angle. A hole through the flattened wall of the tube fits over a nipple, applied through the hole in the dry shell and rolled, beaded and welded, before the circulating trough is in place. The upper end of the nipple is rolled, beaded and welded in the tube, working through the open end of the tube. The end of each tube is closed by plate welded in place, over which



When lagged, the boiler head does not differ in appearance from that of a staybolt type firebox

the edges of the tube are flanged and welded. A space block is applied between the right and left tubes of each pair to relieve the nipples of shearing action.

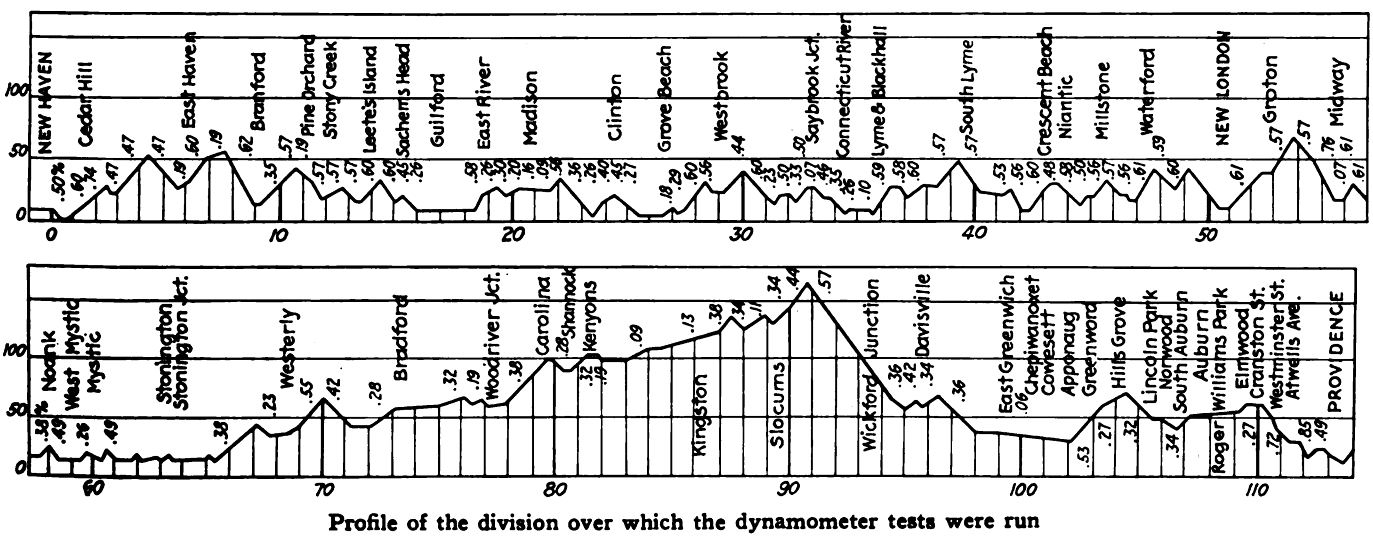
The lagging on the outside of the firebox is composed of a protection plate, insulation and jacket. The lagging is made up in sections with each panel self-contained in order construction and without any lagging or insulation whatever, indicate a very uniform warming up of the entire boiler from front end to back head without the usual unequal heating normally experienced in the radial-stayed construction. The time required to fire up the cold boiler is only two-thirds of the time usually required with the radial-stayed construction. There is a very noticeable scouring action through the tubes of the firebox and combustion chamber, undoubtedly due to the rapid and positive circulation and indicated very definitely by lack of mud and scale in the mudring and tube area. Most of the mud accumulated is relatively soft and is deposited in the



The front side of the throat construction, showing the handholes and circulating trough flange—The mudring flanges are opposite the handhole openings

trough section. In other words, the dead corners of the conventional boiler and firebox are absent in the McClellon construction.

The freedom from unequal heating, momentary distortion of the firebox while warming up, more rapid circulation and absence of dead corners that give rise to mud and scale accumulation all indicate a better type of boiler construction than normally used. The time required to wash one of these boilers is only about one-half or two-thirds of the time required for the ordinary boiler. Stresses due to unequal temperature conditions are greatly



Profile of the division over which the dynamometer tests were run

to permit the removal of lagging in sections without the necessity of wholesale stripping for access to tubes and other parts. The lagging is applied after the tubes have been covered with an asbestos cement.

No detailed study has been made of circulation in this boiler, but observations of the bare boiler, fired-up during reduced as indicated by considerably less maintenance on the firebox and combustion chamber portion of the boiler. Both running and back shop repairs are less on the boilers with this type of firebox than on those with the conventional type of firebox. The ten years' experience of the New Haven indicates that the maintenance cost is reduced

about one-half, and there is also a considerable increase in the time available for service.

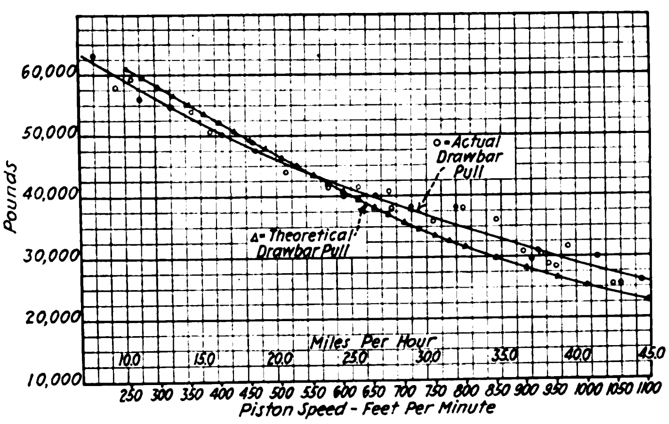
There is greater potential capacity in this type boiler when the locomotive is running before low steam conditions are experienced from any cause than is the case with the conventional locomotive boiler.

The arrangement of outside throttle and superheated steam on most of the auxiliaries is in keeping with present day practice. An Elesco feedwater heater and Duplex stoker are applied, the front end is fitted with Okadee hinges and the air operated whistle uses superheated steam.

When this locomotive was built as many dimensions and characteristics as possible were kept the same as the conventional engines built at the same time from the U.S.R.A. light Mountain type design for fast freight service. Thus, all tests could be made on a comparable basis as between the McClellon firebox and the standard locomotive, thereby eliminating variables that would tend to influence conclusions. Consequently, the cylinder and wheel sizes, grate area, heating surface, superheater surface, etc., were all kept at the same values and the changes in the McClellon equipped locomotive were confined to the firebox arrangement, boiler pressure, valve events and, to some extent, the weight on drivers. Virtually the same limitation on axle loads held good for the McClellon equipped engine as were imposed in the case of the standard type.

Comparison of the principal characteristics of the two locomotives tested

	Engine 3324	Engine 3500
Type	4-8-2	4-8-2
Boiler	Firetube	Firetube
Firebox	Radial-stayed	McClellon
Weight on drivers	230,500 lb.	243,500 lb.
Total weight, engine and tender	518,800 lb.	549,000 lb.
Boiler pressure	200 lb.	250 lb.
Cylinders	27 by 30 in.	27 by 30 in.
Maximum cut-off	85 per cent	70 per cent
Diameter of driving wheels	69 in.	69 in.
Tractive force	53,900 lb.	63,390 lb.
Factor of adhesion	4.28	3.81



A comparison of the theoretical and actual drawbar pull curves for engine 3500

After receipt from the builders in 1924, this locomotive, road No. 3500, was placed in regular freight service and was later subjected to extensive tests in comparison with one of the standard engines, road No. 3324. The tests with both engines were conducted over the same division, from New Haven, Conn., to Providence, R. I., a distance of 113 miles. It will be seen from the accompanying profile that eastbound, with the exception of a start at each end of about three miles, and the climb from Wood River Junction to the summit a mile east of Slocums, a distance of 14 miles, and westbound, from East Greenwich to the same point, a distance of about seven miles, all of the adverse grades may be considered as momentum grades. The profile shows a continued succession of favorable and adverse grades, very few of which are more than two miles long. Particular pains were taken to have all readings the same during both tests, and to have them taken at the same predetermined locations throughout the series of runs. All coal used was accurately weighed by means of scales placed on the tender and was of the same quality for all runs. The average heat value was close to 13,500 B.t.u. per lb. of dry coal.

Dimensions, weights and proportions of engine 3500, equipped with McClellon firebox

Type of locomotive	4-8-2
Service	Freight
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Southern
Valves, piston type, size	14 in.
Cut-off in full gear, per cent	70
Weights in working order:	
On drivers	243,500 lb.
On front truck	59,500 lb.
On trailing truck	57,000 lb.
Total engine	360,000 lb.
Tender	189,000 lb.
Wheel bases:	
Driving	18 ft. 3 in.
Total engine	40 ft. 10 in.
Total engine and tender	76 ft. 5½ in.
Wheels, diameter outside tires:	
Driving	69 in.
Front truck	33 in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	12½ in. by 14 in.
Driving, others	10½ in. by 14 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	McClellon
Steam pressure	250 lb.
Fuel, kind	Bit. coal
Diameter, first ring, outside	78⅜ in.
Firebox, length and width	120 in. by 85 in.
Height mud ring to crown sheet, back	63¾ in.
Height mud ring to crown sheet, front	98¾ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber length	68 in.
Firebox tubes, number and diameter—	
Sides	58—4 in.
Back	28—2 in.
Combustion chamber	30—4 in.
Tubes, number and diameter	201—2¼ in.
Flues, number and diameter	40—5½ in.
Length over tube sheets	20 ft. 6 in.
Grate area	70.8 sq. ft.
Heating surfaces:	
Firebox—	
Drums	81.8 sq. ft.
Back section	46.5 sq. ft.
Side and back tubes	187.0 sq. ft.
Combustion chamber tubes	115.8 sq. ft.
Arch tubes	27.0 sq. ft.
Total	458.3 sq. ft.
Tubes	2,469 sq. ft.
Flues	1,134 sq. ft.
Total evaporative	4,061 sq. ft.
Superheating	1,009 sq. ft.
Comb. evaporative and superheating	5,070 sq. ft.
General data estimated:	
Rated tractive force, 70 per cent cut-off	63,390 lb.
Cylinder horsepower (Cole)	3,090
Steam required per hour (Cole)	58,710 lb.
Boiler evaporative capacity per hour (Cole)	63,072 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	67.7
Weight on drivers ÷ tractive force	3.81
Total weight engine ÷ comb. heat. surface	71
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	107.2
Tractive force × dia. drivers ÷ comb. heat. surface	862.7
Cylinder hp. ÷ grate area	43.7
Firebox heat. surface ÷ grate area	6.5
Firebox heat. surface, per cent of evap. heat. surface	11.3
Superheat. surface, per cent of evap. heat. surface	25.0

One of the tables gives a comparison of the principal dimensions of the two locomotives tested. It will be seen that although both have the same cylinder dimensions, engine 3500 had the advantage of 50 lb. per sq. in. in steam pressure, with a consequent higher tractive force of about 17.6 per cent. This higher tractive force is obtained with an increased weight on drivers of only six per

cent, or in other words, with a reduced factor of adhesion. The locomotive required no more care in handling than the other engines with the higher adhesion factor because of the smoother torque resulting from the relatively shorter cut-offs.

The first tests with engine 3500 were conducted to establish the maximum tonnage which the engine was capable of handling. Starting with 4,000 equated tons on a 75-car basis, the load was increased to 6,547 equated tons. The engine started and accelerated this train without difficulty

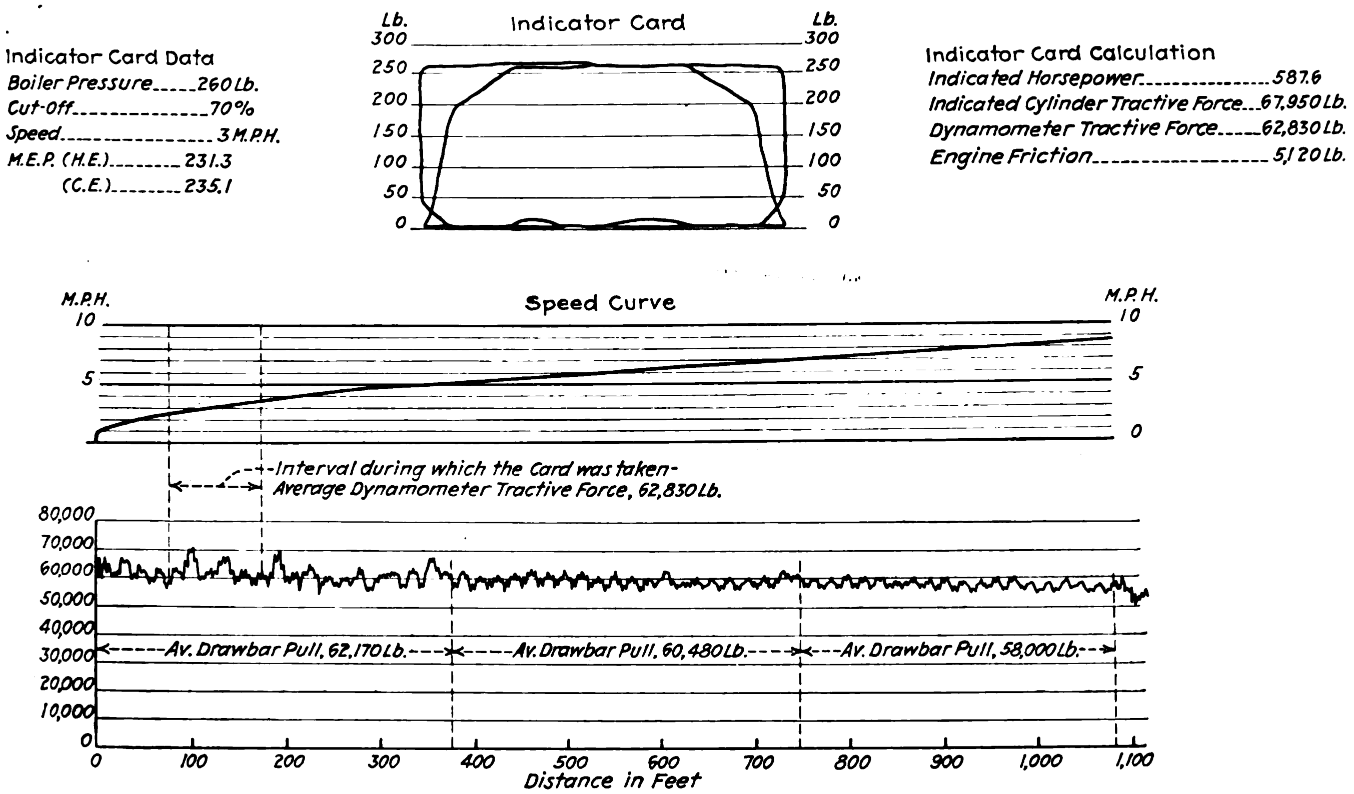
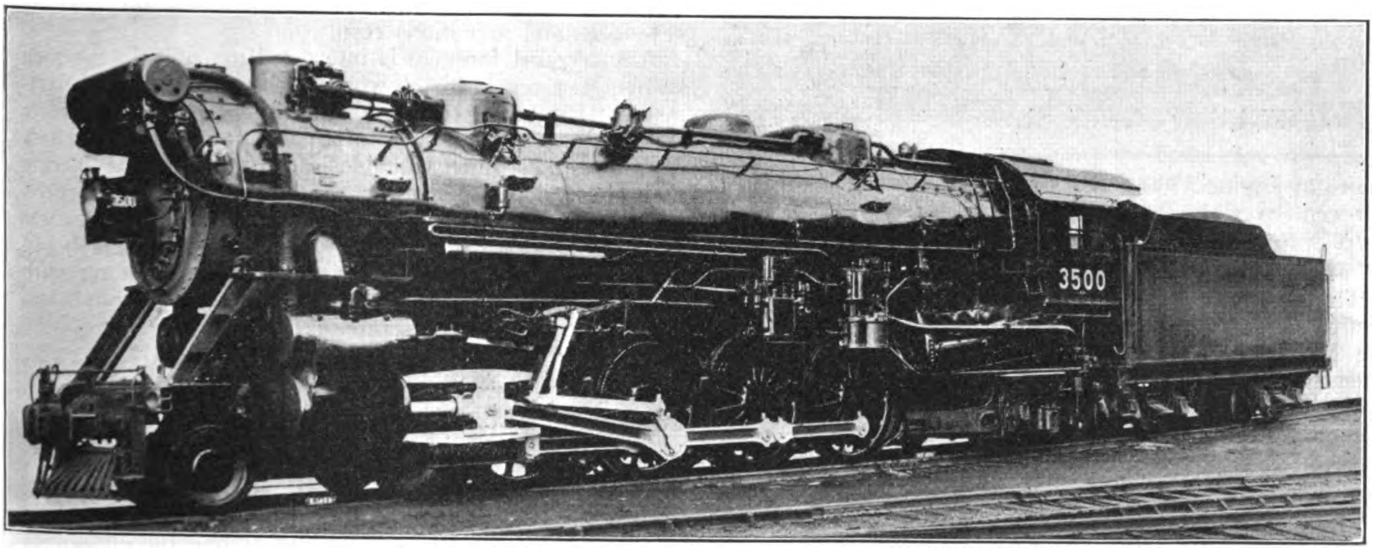


Chart showing the drawbar pull of engine 3500 on a .4 per cent grade east of Saybrook, Conn., starting and accelerating a train of 85 cars and 4,496 tons

A typical indicator card, shown in one of the diagrams, was taken at a time when the engine was hauling 4,496 tons, 85 cars, up a 0.4 per cent grade, just east of Saybrook. The cut-off is given at 70 per cent of the stroke, the speed at 3 m.p.h. The section of the dynamometer car chart shows a very uniform drawbar pull along with uniform acceleration while raising speed up to 8½ m.p.h.

A comparison of the outstanding items in the performance of the two locomotives taken from the summary of the efficiency tests is given in a table.



New York, New Haven & Hartford 4-8-2 type locomotive with McClellon firebox

on a .142 per cent grade. Tests with greater tonnage were prevented by lack of available tonnage because of the coal strike and the maximum capacity of the locomotive is still undetermined.

From these results it may be seen that engine 3500 hauled 3.2 per cent more tonnage than engine 3324, maintaining the same average speed and the same running time over the division, while working at a 16.5 per cent shorter

cut-off and at the same time used 10.7 per cent less coal than did engine 3324. This resulted in a decrease of 15.1 per cent of coal per 1,000 gross ton-miles. No material difference in superheat was noticed in the tests on the two locomotives.

Because of the higher boiler pressure and limited cut-off of engine 3500, a saving of 5 per cent in pounds of water per dynamometer hp. hour was obtained, which, coupled with the 12.0 per cent increase in evaporation per pound of dry coal, resulted in a decrease of 18 per cent in dry coal per dynamometer hp. hour. The McClellon boiler of engine 3500 shows an increased efficiency of 9.4 per cent over the standard boiler of engine 3324, while there was an increase in overall thermal efficiency of 15.5 per cent in favor of engine 3500.

The results of this service and the tests were so satisfactory and so conclusively demonstrated the advantage of the McClellon boiler that, when ten new engines were recently purchased for the road, there was no question or discussion as to the type of boiler to be used. The McClellon water-tube boiler was ordered to be placed in all of them.

Summary of the test results

	Eng. 3324	Eng. 3500	Per cent increase or decrease for Eng. 3500
Test Conditions			
Av. running time, min	254	254	
Av. delayed time, min	88	106	20.0 inc.
Distance miles	107	107	
Av. number of cars per train	90.5	87.0	3.9 dec.
Av. actual tons per train	4,360.6	4,556.0	4.48 inc.
Av. equated tons per train	4,486.5	4,640.0	3.2 inc.
Av. cut-off per cent	44.8	38.5	16.5 dec.
Locomotive output			
Av. drawbar pull, (integrated), lb	27,725	29,306	
Million ft.—lb. work at the drawbar	15,669	16,557	5.7 inc.
Dynamometer hp. (true average)	1,872	1,982	5.9 inc.
Fuel performance			
Coal fired, average per trip	23,725	21,400	10.7 dec.
Coal fired, per dynamometer hp.-hr., lb	2.99	2.55	14.7 dec.
Coal fired per 1,000 gross ton-miles, lb	50.9	44.4	12.7 dec.
Coal fired per sq. ft. grate per hr., lb	79.1	71.6	9.5 dec.
Dry coal per dynamometer hp.-hr., lb	2.95	2.50	18.0 dec.
Dry coal per 1,000 gross ton-miles. lb	49.96	43.41	13.1 dec.
Dry coal per sq. ft. grate per hr., lb	77.6	70.0	9.8 dec.
Average thermal efficiency	6.46	7.47	15.6 inc.
Machine performance			
Av. indicated hp. (reading intervals)	2,503.8	2,696.0	7.67 inc.
Av. dynamometer hp. (reading intervals)	2,203.4	2,347.0	6.52 inc.
Machine efficiency, per cent	88.0	87.0	1.1 dec.
Boiler performance			
Av. boiler pressure, lb	194.8	241.1	24 inc.
Av. superheat, Deg. F	192.5	196.7	2.18 inc.
Water delivered to the boiler, av. per trip, lb.	181,693	182,339	
Water losses, av. per trip, lb.			
Through feedwater heater pump	3,428	3,880	
Through air pumps	7,364	7,367	
Through safety valves	2,303	1,496	
Through generator	423	423	
Through stoker	3,593	3,599	
Per cent total evaporation delivered to cyls.	90.58	90.79	
Actual evaporation, lb. per hr	42,963	43,189	0.5 inc.
Equivalent evaporation, lb. per hr	56,750	56,821	0.1 inc.
Actual evaporation per lb. dry coal, lb	7.81	8.75	12.0 inc.
Equivalent evaporation per lb. dry coal, lb.	10.32	11.50	11.4 inc.
Actual evaporation, lb. per sq. ft. evaporating surface, per hr	10.40	10.64	2.3 inc.
Av. lb. water evaporated per dynamometer hp. hr	22.95	21.8	5.0 dec.
Av. boiler efficiency, per cent	74.59	81.53	9.3 inc.

The Soviet Government, it is reported from London, is exerting every effort to improve and extend its railway facilities. New construction work at the rate of 3,000 miles per annum is planned. A total of 450 locomotives is reported to be under construction. Extensive tests are being made with Diesel locomotives and several of various types are under order to be tested and compared. The volume of traffic has reached 86 per cent of the pre-war level and is constantly increasing.

Foreman has unlimited opportunities and responsibilities*

By R. J. Wilson

Assistant foreman, Norfolk & Western, Norton, Va.

To be a successful foreman one must first of all be a diplomat. The foreman is the human link between employer and employee and it is his job to keep the men who work for him and the men he works for happy, congenial and progressive. First of all, to be worthy of his hire, a foreman must win the men who work for him to put forth their best efforts. This requires patience in the nth degree sometimes, to make each man on the job feel that the foreman is interested in each individual and working for his advancement, and to create this same feeling among the men for their foreman.

A foreman, to keep the men contented and willing to exchange their best efforts for their daily wage must realize that his men are real human beings and not machines. A few friendly words of encouragement often help the workmen over hard places and a lift in time of need or an interesting explanation to apprentices makes them feel that you are their friend and brother, not merely a paid overseer. An organization of contented, ambitious men, who have been led to recognize their foreman as a four-square man, always on the level with them, will give any company better results and larger dividends. The morale of the foreman is usually reflected in the morale of the workingmen.

A foreman should be absolutely honest with his men in all things, so that he can expect the same of them. He should never make promises he is not absolutely certain he can fulfill, or dodge his responsibilities in any way. He should take the blame for the shortcomings and failures in his department and not shift it onto his men.

A foreman should always be able to explain fully and patiently any work required of an employee and if necessary do the work along with the men if it is something new or different than the usual practice. He should never ask an employee to do a dangerous job that he himself can't or won't do.

By inviting criticisms and discussion about handling new items of work or intricate pieces of machinery, interest is encouraged among the employees and valuable new ideas and inventions result.

A successful foreman is interested not only in the men he oversees, but in his co-workers as well in other departments. By taking time to talk things over with other foremen and workers he is often able to avoid petty altercations, gather much valuable information and co-operate with these departments for the benefit of the company.

Any company expects its foremen to watch its expenses as faithfully as they do their own. A foreman should teach his men to be careful with machinery, saving with materials and avoid wasting time. He should watch and discourage the reckless scrapping of materials that can be used again, and the abuse of company property.

The foreman should ever be on the alert to avoid any misunderstandings or misrepresentations between the company he works for and the employees. He should be able at all times to express the attitude of the men towards their company and vice-versa. He is afforded the opportunity of discouraging any undue agitation any one man or group of men may be spreading among the employees and he is also afforded the opportunity of standing by his men and getting better working conditions and equipment for them whenever possible. Truly the opportunities and responsibilities of a wide-awake foreman are unlimited.

* Submitted in the *Railway Mechanical Engineer* competition on the foreman's job.

Power brakes tested at Purdue

Satisfactory trainagraph developed—Impartial brake investigation now making rapid progress

THE American Railway Association is now making rapid progress in its investigation of power brakes and power brake operating appliances for freight trains on a 100-car test rack located at Purdue University, Lafayette, Ind. These tests, which are being carried out under a plan laid down by H. A. Johnson, director of research, were started November 30, 1925, and will continue until all power brake equipment under consideration have been tested. After experiencing considerable difficulty satisfactory trainagraph instruments which practically eliminate the human element in recording original data have been developed and the Type K triple valve tests are about 70 per cent completed.

In making the tests, the director of research was instructed by the Committee on Safety Appliances of the Mechanical Division to proceed upon the following plan:

1. Steps will be taken to obtain appliances, which, it is claimed, meet the views of the Interstate Commerce Commission, as indicated in its preliminary report and conclusions. If the plans or specifications for such appliances are available and the appliances are not yet being manufactured, steps will be taken by the director of research to secure such appliances, even to the extent of entering into an agreement to have such appliances made.
2. As soon as such appliances have been obtained they will be given exhaustive tests on the test rack at Purdue University, which rack will be completely prepared and brought up to date for the purpose of this investigation.
3. Following the completion of the rack tests such devices will be given road tests, to develop whether or not they meet road conditions safely in service.
4. This program will be carried out with all dispatch and as promptly as the devices for these tests are available.
5. The investigation will also embrace such further study as may, in the judgment of the director of research, throw further light upon this problem.

Progress of the work

In accordance with the above plan, inquiries were addressed to the air brake manufacturers to ascertain if they would design and build air brake equipments which would meet the views of the Interstate Commerce Commission. In response to these inquiries two air brake manufacturers, the Automatic Straight Air Brake Company and the Westinghouse Air Brake Company, agreed to furnish such equipments, and in February, 1925, the American Railway Association placed an order with each of these companies for 150 sets of freight train air brake equipments for trial purposes. The Westinghouse Air Brake Company will also submit a second air brake equipment embodying its views as to the desirable functions of an air brake equipment for modern freight train operation.

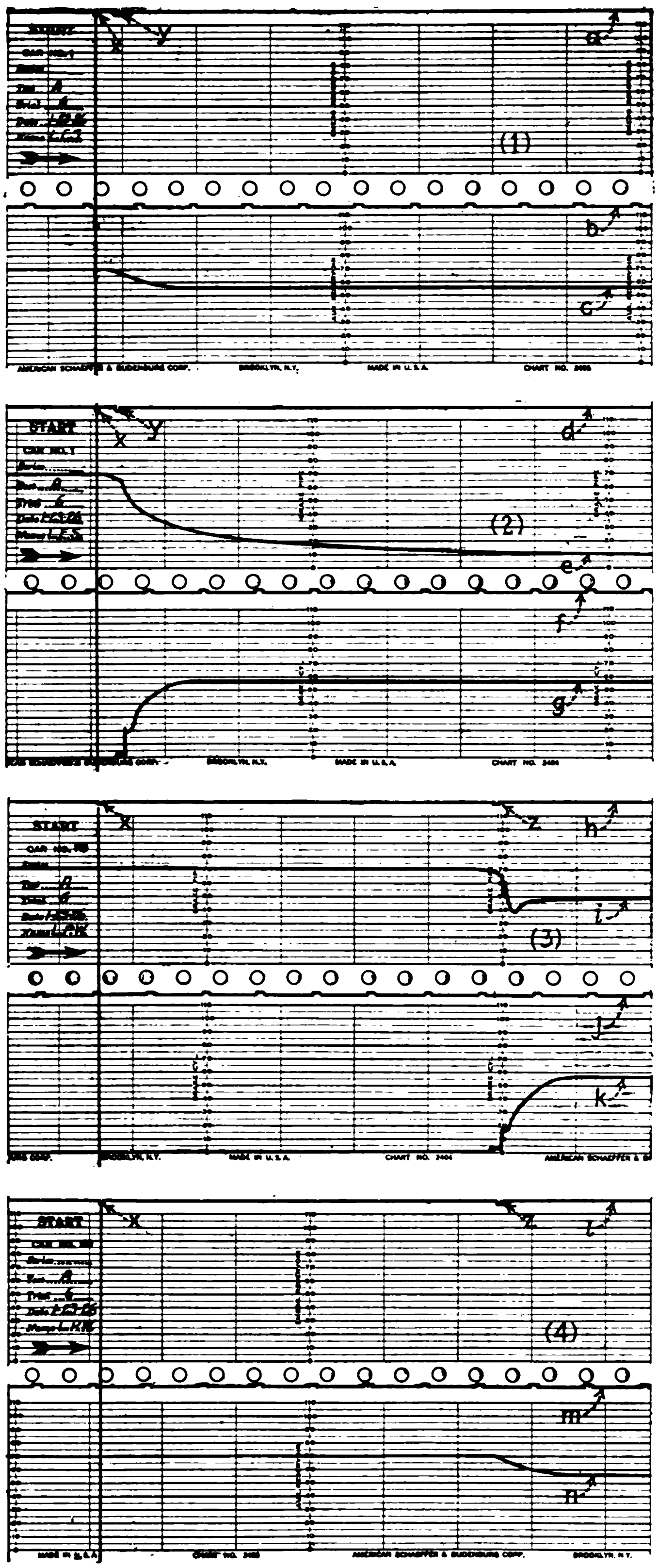
Ever since the orders have been placed, the manufacturers have been busily engaged in designing and building the equipments which they intend to submit. Up to the present time neither of the manufacturers has submitted its apparatus. It is anticipated that the Automatic Straight Air Brake Company will be ready to ship its equipment during the month of February 1926, and that the Westinghouse Air Brake Company will ship its equipment shortly thereafter.

The center aisle of the car rack with the locomotive equipment at the end of the aisle—This shows the brake pipe above with the hose connections between cars, the brake cylinders and yokes and oak blocks for obtaining the various lengths of piston travel—Car equipments from No. 1 to 50 are shown on the right and from No. 51 to 100 on the left

In the meantime the test rack has been completely rebuilt, the new recording instruments designed and installed, a basic schedule of tests developed and agreed upon by the various parties concerned in the investigation and tests started.

It was decided to make the same tests with the present standard air brake equipment for freight trains, known as Westinghouse Type K, as will be made with the new equipments, in order

1. To obtain accurate information concerning the functioning of this equipment,
2. To establish its advantages and short-comings,
3. To obtain a basis with which the new equipments will be compared so as to determine whether such new



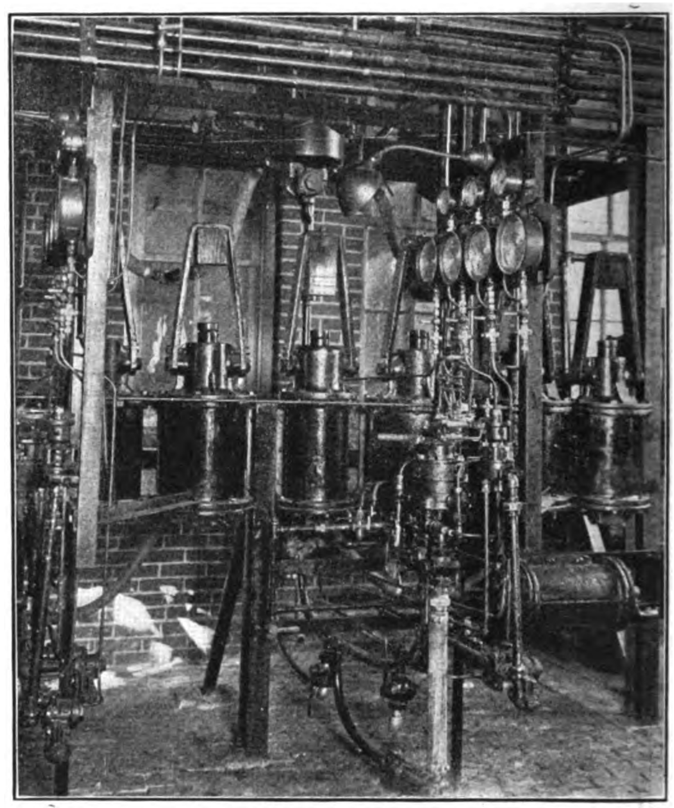
Record of brake action in emergency application on cars Nos. 1 and 100 with Westinghouse Type K 10-in. freight equipments on the Purdue test rack

Trainagraph charts (1) and (2) record brake action on car No. 1. Charts (3) and (4) record brake action on car No. 100. Reference letters a, d, h and e are event lines; b, f, j and m are time lines, with the distance between each notch representing one second; c, e and g are the auxiliary reservoir, brake pipe and brake cylinder pressures respectively on car No. 1; i, k, and n are the brake pipe, brake cylinder and auxiliary reservoir pressures, respectively, on car No. 100. Points x indicate brake valve movement; points y, initial piston movement on car No. 1, and points z initial piston movement on car No. 100.

equipments represent sufficient progress in the art of train braking to warrant their adoption.

Preparing test rack for the investigation

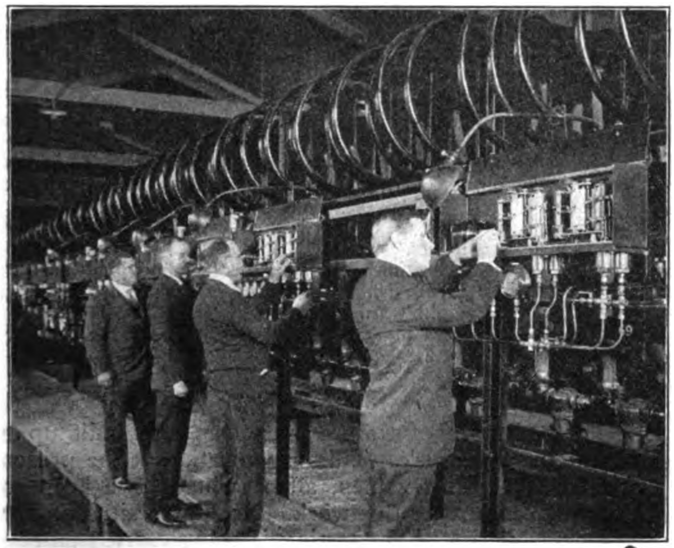
The American Railway Association air brake test rack is located in a separate building approximately 35 ft. wide by 100 ft. long adjacent to the testing laboratories at Purdue University. It consists of two main parts, the locomotive rack and the car rack. It was necessary to dismantle the locomotive rack and move it to a new location in order to provide more space for the new sections of the car rack. The old locomotive equipments were replaced with two new type No. 6-ET locomotive brake equipments, which are so installed that one or both locomotives may be used in the tests. Two new 8½-in., 150 cubic ft. cross compound air compressors were installed near the locomotive rack and were so piped that either or both compressors could be used.



Part of the new locomotive racks; the automatic and independent brake valves of locomotive No. 2, are shown; also the locomotive and tender brake cylinder gages, vent valve and piping

The old car rack, of sufficient size to accommodate 100 type K brake equipments, was not large enough for the new brake equipments which are to be tested. It was necessary to add four new sections to the car rack, and equipments were arranged so that there would be five brake equipments in each section. During this rearrangement of equipments, all piping was taken off the rack, hammer tested, blown out, replaced on the rack and blown out again. All brake cylinders were taken off the rack, cleaned, checked for wear, new packing cups installed and cylinders re-lubricated. All reservoirs were blown out and checked for leaks. The length of brake pipe per car was increased from 42 ft. to 50 ft., since the latter figure represents present day conditions in freight equipment. All hose and gaskets were replaced with new material. In other words, the entire rack was given a complete overhauling.

A new recording trainagraph was developed for this investigation. Each trainagraph is driven by a 110-volt, 60-cycle alternating current synchronous motor, so that all trainagraphs operate at the same speed. Each instrument has four pressure pens and four time pens. The four pressure pens automatically record the pressures in the brake pipe, brake cylinder, auxiliary and emergency reservoirs. Two of the time pens are electrically connected to a master clock and automatically indicate seconds on the charts, while the other two pens indicate on each chart the movement of the brake valve handle either to the service position or release position, which



(Right to left) H. A. Johnson, director of research, A. R. A., Professor Harry Robenkoenig, Purdue University, W. S. Helmer, engineer power brake investigation, A. R. A., and Professor G. A. Young, head of the school of mechanical engineering, Purdue University, shown adjusting a group of car trainagraphs. In the instrument in the foreground, the alternating current synchronous motor, the two charts, gages and copper pipe connection can be plainly seen

ever is desired. Since the brake valve event occurs at the same instant on all instruments, means are hereby provided for synchronizing all charts to a common starting point, the movement of the brake valve to the operative position.

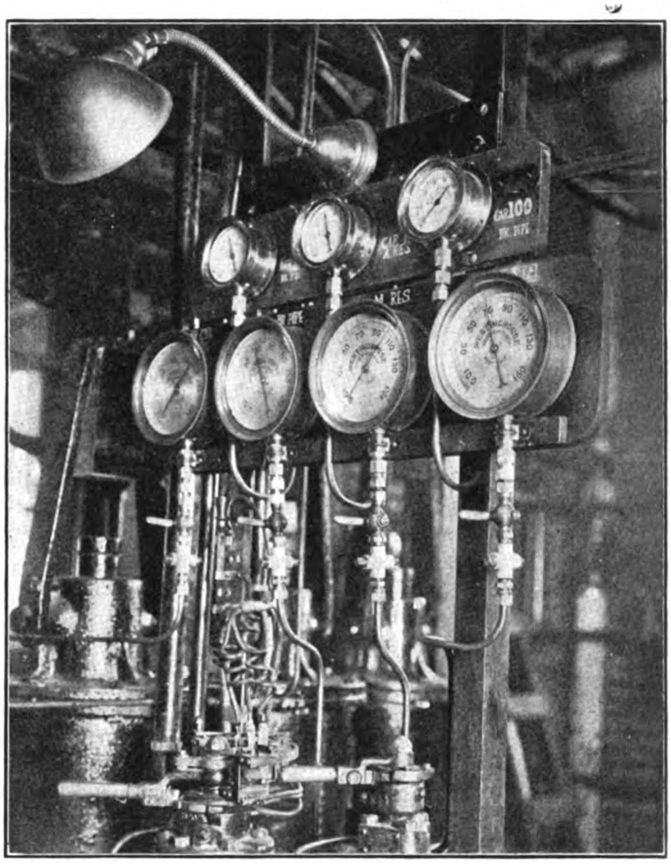
For example, on the trainagraph charts illustrated, which show brake action in emergency application on cars No. 1 and 100 with Westinghouse type K, 10-in. freight equipments on the test rack, the four points *x* all on the same vertical line show the point of brake valve movement on each chart. Points *y*, indicating the initial piston movement on car No. 1 occur .4 second later than the brake valve movement. The gradual reduction of auxiliary reservoir pressure to 57 lb. is shown on line *c*. Brake pipe pressure drops more rapidly to a low point of 10 lb. as indicated by line *e*. Brake cylinder pressure builds up almost instantaneously with the first injection of air from the brake pipe and then more gradually as it
Five gauges have been installed at each car equipped
equalizes with the auxiliary reservoir pressure at 57 lb. Points *z* indicating the initial piston movement on car No. 100 are observed from the chart to occur 7.1 seconds after the movement of the brake valve handle or, in other words, the brake on car No. 100 sets 6.7 seconds after the brake on car No. 1 sets. The variation in brake pipe, brake cylinder and auxiliary reservoir air pressures on car No. 100 can be accurately determined from an examination of lines *i*, *k* and *n*.

On eight cars distributed throughout the 100 car train the brake cylinders are equipped with circuit breakers so arranged that the electrical circuit is momentarily broken when the brake cylinder piston starts to move to application position and is again momentarily interrupted when the piston returns to release position. The operation of each of these circuit breakers makes an indication on the record chart for its respective car of the exact instant its brake cylinder piston started to apply and again when it returns to the release position.

A special locomotive trainagraph instrument was also developed to show at all times the position of the brake valve handle. This instrument also automatically records the pressures in the main reservoir and equalizing reservoir of the locomotive and the brake valve event as explained above for the car trainagraphs.

Thirty-four car trainagraphs and two locomotive trainagraphs have been built and have been installed on the test rack.

Five gages have been installed at each car equipped with a trainagraph for the purpose of checking the pressures shown by the instrument. All gages and train-



Close-up of the gages at the brake valve operator's position—The special electric wiring for recording the movement of the brake valve handle can be seen on the upper part of the automatic brake valve

agraphs have been calibrated and calibration curves prepared.

Mercury manometers were built and installed on cars No. 50 and 100 for the purpose of accurately measuring the brake pipe pressure at these cars in pounds per square inch and tenths thereof.

Three large storage batteries furnish direct current at 6 volts, 12 volts and 24 volts needed for the operation of the trainagraphs and the 110 volt alternating current is furnished by the University power plant. A very extensive system of electric circuits was installed on the car

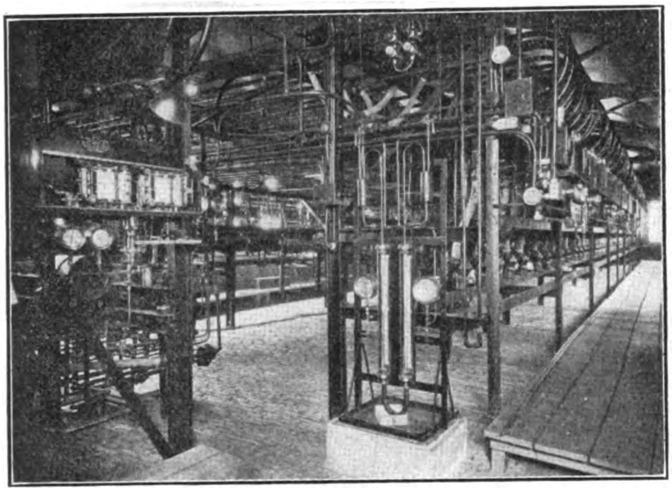
rack not only for lighting, but also for operating the trainagraph motors, the time and event pens and a trainagraph operator signal system. All of this wiring was installed in metallic conduit with approved switches and outlet boxes.

After all the piping and equipment had been installed, the brake pipe leakage for the 100-car train was reduced to less than 2 lb. per min. The leakage of each brake cylinder was also reduced to less than 2 lb. per min. In certain tests, however, artificial brake pipe leakage of 7 lb. per min. and artificial brake cylinder leakages of 5 lb., 12 lb., and 17 lb. per min. will be created by means of fixed orifices.

The basic schedule of tests

The first draft of the basic schedule of tests was sent to the following parties, who are concerned in this investigation, in the month of July, 1925.

W. P. Borland, director of the Bureau of Safety, Interstate Commerce Commission, Washington, D. C.; H. I. Miller, vice-president and general manager, Automatic



At the extreme left is shown one of the special locomotive trainagraphs, which is similar in appearance to the car trainagraphs—In the center foreground can be seen the mecury manometer at car No. 100—At the extreme right a good view is obtained of the instruments and equipments on cars No. 51 to 100

Straight Air Brake Co., New York, N. Y.; C. C. Farmer, director of engineering, Westinghouse Air Brake Company, Pittsburgh, Pa.; C. E. Chambers, chairman, Committee on Safety Appliances, Mechanical Division, American Railway Association; and V. R. Hawthorne, secretary, Mechanical Division, American Railway Association, for transmittal to the members of Committee on Brakes and Brake Equipment. Shortly thereafter conferences were held with each of these parties to ascertain their criticisms and suggestions for new tests.

After all of these suggestions had been included in the second draft of the basic schedule of tests, it was again sent out in October, 1925, to the parties referred to above for further criticisms, suggestions or approval. This draft was approved with some suggestions for additional tests. The basic schedule of tests is divided into the following main headings:

1.—Individual triple valve tests. (Single car.)
2.—100-Car train—level road conditions,—direct release.
3.—100-Car train—grade conditions—graduated release or retainers.
4.—50-Car train—grade conditions—graduated release or retainers.

The basic schedule of tests contains 565 separate tests which is indicative of the scope and extensiveness of this investigation. All equipments under consideration will be run through each test in this schedule. A large number of the tests in this schedule have been designed to reproduce conditions which are met in actual freight train service. The making of these tests in the research laboratory will result in the shortening of the time required to make the road tests.

The following freight train equipments will be tested on the rack.

1. Standard type K triple valves in order to determine the exact functions of present standard brakes for a basis of comparison with the new brake systems which will be tested.
2. Type K triple valves with heavier-than-standard graduating springs to determine the effect of these springs upon the functioning of the K triple valves.
3. Automatic Straight Air Brake equipment.
4. Mixed equipments of standard type K triple valves and Automatic Straight Air Brake equipments.
5. New Westinghouse air brake equipments, which, in this company's opinion, meet the views of the Interstate Commerce Commission.
6. Mixed equipments of standard type K triple valves and new Westinghouse equipments.
7. A second new Westinghouse equipment embodying this company's views as to the desirable functions of an air brake equipment for modern freight train operation.
8. Mixed equipments of standard type K triple valves and the second new Westinghouse equipments.

Personnel of rack tests—completion

An organization of trained men has been built up to carry on the test work. This organization at the present time consists of thirty men, all of whom have been especially picked out for this work. No University students are being employed. The testing is being carried on continuously working 44 hours per week. While one force of men are making tests on the rack, another force of men are compiling the results from the records made in the research laboratory.

Representatives of the Interstate Commerce Commission are present in the research laboratory at all times during the conduct of the tests. The air brake manufacturers have been invited to send representatives to be present not only during the testing of their own equipment, but also during the testing of the other brake equipments under consideration.

From the time being taken to test out the equipments under the first and second series, namely, the standard type K brake equipments and the type K brake equipments with the heavier-than-standard graduating springs, an estimate of approximately two months per equipment can be made. At this rate it will take practically all of the year of 1926 to complete the rack tests. Methods for reducing the time required to test an equipment are now under consideration.

"News as is news" is the heading of a bulletin which has been issued by the safety department of the Philadelphia division of the Pennsylvania, announcing the fact that the maintenance of equipment department on that division "has established a wonderful record" during the year 1925. Sixteen shops or departments reported no accidents, and ten shops or departments reported one accident each. During the last half of the year three shops in the Harrisburg district showed decreases, as compared with the same period of 1924, as follows: Maclay Street (1,936 employees), 120 accidents last year, 76 this year; decrease, 37 per cent. Lucknow (557 employees), 28 accidents last year, 11 this year; decrease, 60 per cent. Enola (1,822 employees), 210 accidents last year, 42 this year; decrease, 80 per cent.

The scoffer is exhorted "to go and do likewise; *it can be done.*" And the final appeal, at the bottom of the page, is—

DOES THIS MEAN ANYTHING TO YOU?

Standardizing apprentice training

A reason advanced for the comparatively slow extension of modern apprenticeship methods

By C. Y. Thomas
Supervisor of apprentices, Kansas City Southern

THE benefits of a thorough system of railway shop apprentice training have been widely discussed and the establishment of such a system advocated in the technical publications and before the American Railway Association by the leading mechanical men in the country, but the unusually slow extension of this work indicates that there must be some distinct causes for the apathetic attitude towards it. If apprentice training is good for one railway then it must have the qualities of being beneficial to all.

Hard to show tangible results

The main difficulty in starting a system of school and shop instruction for apprentices is that its value is rather intangible, making it a perplexing problem to show in "black and white" that education is an asset and worth capitalizing, or that the money expended in this direction will be returned in savings of time and material. The outlay for opening a school and providing a competent instructor is a large item and demands attention because of the fact that the school work must be kept on a high plane, abreast of the times, and at a reasonably low cost to attract the attention of mechanical officers.

Textbooks should be standardized

Railroading, after all, is much the same the country over; a blueprint in Maine may be read in California and a speed and feed problem in Minnesota is met with in Louisiana. The two main subjects of school instruction are mechanical drawing with its allied blueprint work, and mathematics. Yet in teaching the fundamentals of these subjects, it is strange to note that no two systems of schools use the same mathematics textbook. Exponents of apprentice training agree that there is no textbook published which covers the applications of the railroad field as they believe they should be covered. Also there is a divergence of opinion regarding mechanical drawing; no suitable textbook has been found. The cost of each road working up its own texts is considerable, whether typed, printed or blueprinted, and it is difficult to understand why a standard set of texts has not been worked up and adopted by all in the interests of economy.

If supervisors of apprentices cannot agree on the fundamentals of apprentice training, it is reasonable for others to consider the work in an experimental stage, unsettled and lacking in worth and stability. It is stated that conditions on one road differ from those on another and yet for the most part of the apprentice school work, the subjects are essentially the same and should be standardized.

Three-fourths of school work can be standardized

Standardization of apprentice school work could be achieved to the extent of three-fourths of the work given in the school, allowing one-fourth of the time for subjects peculiar to the individual road, such as studying the road's locomotive folio or locomotive and car inspection rules where they differ from those established by federal rulings.

As a basis for standardizing school work, the subjects which could be most readily worked out are mechanical drawing, blueprint reading, mathematics, valve gears, shoes and wedges, safety appliances, interchange rules, etc. The great value of these standards would be that men changing from one road to another would be better prepared. The value of standardization which would appeal most to the higher authorities would be that of lower costs of starting and maintaining the apprentice schools.

Those roads which do not have apprentice schools would find it far easier to establish them if they could start right in at a minimum of expense with a school curriculum already three-fourths worked out; they could profit from the experience of other roads which had mapped out the best possible range and handling of subjects.

Standardization can be further carried out by the adoption of standard school equipment, such as T-squares, triangles, instruments, drawing boards, paper, etc. The larger volume of purchases would appreciably lessen costs.

Some trades badly neglected

Standardization is always opposed by those who fear to lose individual distinction, yet the abandonment of this selfish idea in favor of co-operation will result in placing the work on a higher and more useful standard. The trades which are numerically the largest have been receiving the most attention in school work and the criticism which may be rightfully directed at the present school systems is the tendency to minimize the trades which have few apprentices and not give school work particularly suited to their individual needs. In this group may be classed the trades of electrician, blacksmith, upholsterer, pattern maker, painter and coach carpenter. Some apprentice schools are gradually working up courses for these but it stands to reason that the co-operation of all would speed up the process.

Need of organized effort

The primary difficulty in working up the standard texts would be the lack of organization. The total number of apprentice instructors and supervisors of apprentices in this country probably totals about two hundred. They are generally staff men. If they are too widely scattered to have an organization of their own, then it would seem entirely in order for the A. R. A. through Division V to have a committee on this subject, which can work out standards, make revisions and thus make available to all the very much worthwhile benefits of apprenticeship.

AN INTERNATIONAL ORGANIZATION which aims to serve as a meeting ground for unionized railway employees has been functioning in Europe for the past several years. The organization is known as the International Transport Workers' Federation. Headquarters are at Amsterdam and railway unions representing practically all important European countries are affiliated; the only union on this continent included is the Canadian Brotherhood of Railroad Employees.

Examples of recent locomotives of the 4-6-2 type

Arranged in order of weight

Railroad	No. Pac.	A. T. & S. F.	Penn.	So. Pac.	U. S. R. A.	Can. Pac.	Sou.	B. & A.	D. L. & W.	Mo. Pac.	L. V.	Read.	L. & N.	A. C. L.	N. Y. C.	U. S. R. A.	M. & O.	M.-K.-T.
Road class or number	Q-6	3,400	K-4s	P-10	Heavy	2,322	6,684	590	1,189	6,624	K-6-B	G-2-SB	282	P-5-B	6,503	Light	261	409
Builder	Amer.	Bald.	R. R.	Bald.	A. & B.	Mont.	Amer.	Amer.	Amer.	Amer.	Amer.	Bald.	Amer.	Bald.	Amer.	A. & B.	Bald.	Lima
Ordered or built	1922	1924	1924	1923	1918	1923	1923	1924	1923	1924	1923	1924	1924	1924	1924	1918	1923	1922
Tractive force, engine, lb.	41,900	40,900	44,470	43,660	43,900	42,500	47,500	42,900	43,100	44,000	41,500	44,200	40,700	43,100	32,200	40,700	40,700	40,750
Tractive force, booster, lb.	10,500	.....	.....	.....	.....	.....	.....	9,700	.....	.....	10,400	.....	.....	.....	9,700	.....	.....	.....
Cylinder horsepower (Cole)	2,312	2,252	2,690	2,252	2,624	2,252	2,624	2,434	2,252	2,427	2,421	2,477	2,252	2,252	2,076	2,252	2,252	2,252
Speed m.p.h. at 1,000 ft. piston speed	46.55	46.55	51.0	43.75	50.32	44.63	46.55	47.82	44.03	46.55	49.1	47.2	46.55	44.03	54.2	46.55	46.55	46.55
Weight of engine, lb.	322,000	312,040	309,140	307,300	306,000	300,500	299,000	298,000	297,500	295,500	291,000	288,120	284,000	280,610	278,000	277,000	274,640	273,000
Weight on drivers, lb.	197,000	191,220	202,880	183,100	197,000	179,300	179,500	185,500	190,500	188,000	181,000	177,210	177,000	177,480	169,000	162,000	164,660	167,000
Weight on front truck, lb.	60,500	63,030	52,880	61,200	49,000	61,300	59,500	53,500	52,000	49,500	50,100	51,170	52,500	50,800	53,000	57,000	54,580	56,000
Weight on trailing truck, lb.	64,500	57,790	53,380	63,000	60,000	59,900	60,000	59,000	55,000	58,000	59,900	59,740	54,500	52,350	56,000	58,000	55,400	50,000
Weight of tender, lb.	198,500	241,960	....	239,700	194,200	188,400	197,000	204,000	185,700	235,400	197,500	183,480	194,000	187,790	207,000	194,000	203,360	201,500
Wheel base, driving, ft. and in.	13—2	13—8	13—10	13—0	14—0	13—2	13—0	13—8	13—0	13—0	13—8	13—10	13—0	13—0	13—8	13—0	13—0	13—0
Wheel base, engine, ft. and in.	36—9	34—11	36—6	35—6	36—2	34—9	36—1	36—11	33—11	35—3	36—6	35—9	34—11	34—11	36—5	34—9	34—11	35—3
Wheel base, eng. and tender, ft. and in.	71—6¼	72—1⅝	.....	77—3½	70—8½	67—1	71—7	71—11½	69—10½	74—10	72—2	71—10¾	70—7½	70—9½	71—2	68—7½	70—9	71—1¼
Cylinders, diameter and stroke, in.	26x28	25x28	27x28	25x30	27x28	25x30	27x28	26x28	25x28	27x28	25x28	25x28	25x28	25x28	24x26	25x28	25x28	25x28
Driving wheels, diameter, in.	73	73	80	73½	79	75	73	75	69	73	77	74	73	69	79	73	73	73
Steam pressure, lb.	190	200	205	200	200	200	200	200	200	185	215	220	200	200	200	200	200	200
Fuel	Sub. bit.	Oil	Bit. coal	Oil	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Ant. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Oil
Boiler, diameter, first ring, in.	80	78	82⅛	78	78	78½	76⅝	81	76¼	76⅝	74	72	74⅝	76⅛	70⅝	.....	76	75 1/16
Firebox, length, in.	120⅛	114	126	120⅞	120⅛	111⅛	128⅛	108⅛	111⅛	114	120 1/16	126¼	114⅛	114⅛	105⅜	114⅛	114⅛	115
Firebox, width, in.	84¼	84	80	84	84¼	84⅜	84¼	90¼	75¼	84¼	90	108⅛	84¼	84¼	77¼	84¼	84¼	72
Tubes, no. and diameter, in.	190—2¼	214—2¼	237—2¼	193—2¼	216—2¼	205—2¼	216—2¼	210—2¼	260—2	199—2	199—2¼	163—2¼	188—2¼	188—2¼	175—2¼	188—2¼	188—2¼	243—2
Flues, no. and diameter, in.	42—5½	40—5½	40—5½	40—5½	40—5½	38—5½	40—5½	45—5½	36—5⅜	40—5⅜	40—5½	30—5½	36—5½	36—5½	37—5½	36—5½	36—5½	36—5⅜
Length over tube sheets, ft. and in.	18—0	21—0	19—0	18—0	19—0	18—6	18—6	21—0	17—0	20—3	17—0	19—0	19—0	19—0	21—6	19—0	19—0	20—0
Grate area, sq. ft.	70.3	66.8	69.3	70.5	70.8	65	70.5	67.8	58.1	66.8	75.3	95	66.8	66.7	56.6	66.7	66.7	57.5
Coal rate, lb. per sq. ft. grate per hr. (Cole)	107	110	126	104	120.5	112.5	121	117	126	118	105	85	109.5	110	119	110	110	127.5
Steam required per hr.—lb. (Cole)	48,100	46,840	55,950	46,840	54,600	46,840	54,600	50,600	46,840	50,500	50,400	51,500	46,840	46,840	43,200	46,840	46,840	46,840
Heat. surface, firebox, total, sq. ft.	335	270	307	283	327	298	290	252	291	272	328	292	273	275	228	261	269	230
Heat. surface, tubes and flues, sq. ft.	3,084	3,841	3,728	3,069	3,497	3,232	3,399	3,940	3,156	3,235	2,957	2,633	3,074	3,076	3,193	3,072	3,072	3,542
Heat. surface, total evap., sq. ft.	3,419	4,111	4,035	3,352	3,824	3,530	3,689	4,192	3,447	3,507	3,285	2,925	3,347	3,351	3,421	3,333	3,341	3,772
Superheating surface, sq. ft.	928	998	1,172	836	887	803	905	1,163	756	980	845	675	830	824	639	794	794	880
Comb. evap. and super. surface, sq. ft.	4,347	5,109	5,207	4,188	4,711	4,333	4,594	5,355	4,203	4,487	4,130	3,600	4,177	4,175	4,060	4,127	4,135	4,652
Tender, water capacity, gal.	10,000	12,000	9,000	12,000	10,000	9,600	10,000	10,000	10,000	12,000	10,500	9,000	10,000	10,000	10,800	10,000	10,000	10,000
Tender, fuel capacity, tons or gal.	14	4,000	13	4,000	16	12	16	16	10	16	15	15	16	16	16½	16	16	4,000
Weight on drivers ÷ weight eng., per cent.	61.2	61.3	65.6	59.6	64.4	60.5	60.1	62.3	64.0	64.6	62.2	61.5	62.4	63.2	60.8	58.5	60.0	61.1
Weight of drivers ÷ tractive force	4.70	4.67	4.56	4.12	4.49	4.22	3.78	4.32	4.42	4.27	4.32	4.01	4.35	4.12	5.24	3.98	4.05	4.10
Weight of engine ÷ cylinder hp.	139.2	138.6	114.8	136.4	116.5	113.75	113.9	122.3	132.0	121.8	120.2	116.4	126.0	124.6	134.0	123.0	121.9	121.2
Weight of engine ÷ comb. h. s.	74.1	61.1	59.4	73.4	65.0	69.3	65.1	55.6	70.8	65.9	70.4	80.1	68.0	67.2	68.5	67.1	66.4	58.7
Comb. heat. surface ÷ cylinder hp.	1.88	2.27	1.93	1.86	1.79	1.94	1.75	2.20	1.86	1.85	1.70	1.45	1.85	1.85	1.96	1.83	1.48	1.67
Tract. force ÷ comb. heating surface	9.64	8.01	8.54	10.42	9.32	9.78	10.23	8.01	10.25	9.81	10.05	12.28	9.75	10.32	7.94	9.88	9.85	8.76
Tract. force × dia. drivers ÷ comb. h. s.	704	584	683	766	737	734	755	601	708	716	774	909	712	713	627	720	709	640
Cylinder hp. ÷ grate area	32.9	33.7	38.8	32.0	37.1	34.6	37.2	35.9	38.8	36.3	32.2	26.1	33.7	33.8	36.7	33.8	33.8	39.2
Comb. heat. surface ÷ grate area	61.8	76.5	75.1	59.4	66.5	66.7	65.2	79.0	72.4	67.2	54.9	37.9	62.5	62.6	71.7	61.9	62.0	80.9
Firebox heat. surface ÷ grate area	4.76	4.04	4.43	4.01	4.61	4.58	4.11	3.70	5.01	4.07	4.36	3.07	4.08	4.13	4.03	3.92	4.03	4.00
Firebox surface, per cent evap. h. s.	9.80	6.57	7.61	8.41	8.55	9.44	7.86	5.98	8.45	7.75	9.99	9.99	8.16	8.21	6.66	7.83	8.06	6.10
Superheat. surface, per cent evap. h. s.	27.12	24.27	27.91	24.95	23.20	22.75	24.52	27.75	21.93	27.95	25.74	23.08	24.80	24.60	18.68	23.80	23.76	23.33
Notes	a-g	b-e	b	b-e	b	a	a	a-g	a	a-d-i	a-g	b	a	b	a-g	b	b	b

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; d—Syphon; g—Booster; i—Harter circulating plates.

Motive power developments on European roads*

High pressure locomotives with auxiliary low pressure steam turbine tenders may be expected

By W. H. Finley
Consulting engineer, Chicago

As much doubt exists in Europe regarding the type of major motive power that will eventually be developed as there is in the United States. Leaving out of consideration, for the present, small power units such as self-propelled motor cars, European opinion seems to be divided between the turbo- and the Diesel locomotive. With all the publicity that has been given these two types, I found no turbo-locomotive in commercial use in Europe and but one Diesel locomotive, the latter being in operation in Soviet Russia. This locomotive was built in Germany and has been in operation in Russia for some time. Its performance and record is being carefully watched by railroad men and manufacturers.

Diesel-electric unpopular—Only one turbo-locomotive in use

I was surprised to find that the consensus of opinion was against the practicability of the Diesel locomotive, electrically driven. Of the steam turbine developments under the Zoelly or Ljungstrom systems, outside of one or two experimental locomotives, the only one in actual use was the Ljungstrom steam turbine locomotive in Sweden. This locomotive is held at Stockholm on the Swedish State Railways for experimental and demonstration purposes, although it is occasionally used for special runs when there is a shortage of other power. The Ljungstrom company has had built and delivered to the Argentine a steam turbine locomotive which was received in the latter country in November and was expected to be in active service by this time. This locomotive, as expected, shows some improvements over the first experimental effort.

Beyer, Peacock & Company, Ltd., Manchester, England, is building a turbo-locomotive under the Ljungstrom patents, expected to be completed by this date and given its initial test on the London, Scottish & Midland Railway on the run from London to Glasgow. I was advised by an officer of the builders that this company has under consideration the development of a Diesel locomotive and will be prepared to furnish either type.

At the works of Henschel & Sohn, Cassel, Germany, I saw the testing in the yards of a 400-hp. Diesel locomotive, using solid injection and equipped with a Lentz gear transmission. While admitting that the present type of design is limited to slow speed of both driving and driven shafts and a limited range of speed of the driven shaft as well, belief was expressed that it could be so modified as to admit both high speeds and a wider range. The mechanical efficiency was given as 80 per cent. If this 400-hp. Diesel locomotive with the Lentz transmission works out satisfactorily, Henschel & Sohn expects to build a 1,000-hp. machine of the same type. Final decision will depend on the further reports of the operation of the Russian 1,000-hp. Diesel electric locomotive. Electric transmission was not regarded favorably by this company on the ground that it was too expensive (first and last), heavy, bulky, and too complicated. Their opinion is that the Diesel locomotive (provided that the transmisison can be solved) will be in limited demand for (a) intermittent yard switching and where there is a penalty against smoke and dirt, and (b) on branch and main line work of railroads in localities where water is scarce—where cheap oil fuel is available—and where coal prices are high.

Turbo-condensing tender being developed

Henschel & Sohn is now developing and building a turbo-condensing locomotive tender for coupling to a 1,200-hp. piston locomotive. The tender will contain a low pressure turbine with drive and condenser, thereby adding approximately 600 hp. to the drawbar pull of the locomotive without the expenditure of additional fuel. The oil in the exhaust steam from the reciprocating engine will be extracted to the extent of about 95 per cent. A favorable result is anticipated as a water cooled surface condenser is less affected by oil than an air cooled type. This company has also completed plans for a 2,000-hp. Zoelly type turbo-locomotive, featuring boiler, turbine with drive, and condenser on one frame. If this turbo-condensing tender proves successful the builder will proceed with a 2,000-hp. rigid wheel base locomotive and low pressure tender.

At the Krupp plant at Essen, Germany, I looked over the Krupp-Zoelly turbine locomotive that had been completed and had made some test runs on the German State Railways. This locomotive is a decided improvement over the experimental Zoelly turbine locomotive at the plant of Escher Wyss & Company, Zurich, Switzerland. It must be remembered, however, that the experimental locomotive at the Swiss plant was a converted steam locomotive and, in building the Krupp-Zoelly machine, a better arranged and more symmetrical looking unit was produced. Krupp is giving special attention to the development of a Diesel locomotive and is building a 1,000-hp. locomotive type, featuring a gear drive with magnetic clutch. This company also has plans under way for a 2,000-hp. Diesel locomotive but is not pushing it, awaiting more information as to the performance of the 1,000-hp. Diesel locomotive in operation in Russia.

In all the places visited, I found a decided doubt in the minds of many as to the commercial success of the Diesel-electric engine now in use in Russia. Some were very emphatic in their opinion that it was not a success, claiming that troubles had developed and the electric transmission was one of the items causing the most concern.

There is no doubt that the introduction of a low com-

* Abstract of an address delivered before the Western Railway Club, Chicago, February 15, following a two months' trip through France, England, Switzerland, Germany and Sweden in which Mr. Finley, who was formerly president of the Chicago & North Western, called upon many European railroad men and prominent manufacturers in the equipment field.

pression, solid injection engine has given the semi-Diesel quite a boost and as a result the steam advocates have awakened and are making great developments in the prime mover using steam. At the works of Henschel & Sohn, Cassel, previously referred to, I saw a converted steam locomotive from the German State Railways that generated steam at 90 atmospheres and used a working pressure of 60 atmospheres, or 900 lb. When I saw this locomotive it had just come in from a run on the German State Railways.

Insistent demand for self-propelled cars

The demand for a small self-propelled car is just as insistent in England and on the Continent as in America. In conversation with the chairman of the board of Beyer, Peacock & Company, Ltd., he stated that what England needed was some form of small efficient self-propelled railroad car to enable the railroads to compete with the steam and petrol buses and lorries used on the highways. In Germany I found the same condition and the railroads are developing both Diesel and steam power for motor car work. Cars of both types in actual use are about equally divided, with the Diesels averaging slightly higher in power. Larger power units of both types of cars are contemplated. The steam cars are coal fired and are reported as having the advantage over the Diesels in both first cost and operating cost. Some plans of these cars suggest the revival of the Ganz idea. I also understand that plans are being developed for a small (500-hp.) automatically coal fired locomotive which will be operated by one man.

The Swedish State Railways are going in rapidly for electrification and this fact is engaging the attention of their organization to the exclusion of many other things. The State Railways own and operate no internal combustion motor cars. At one time they had a 100-hp. Diesel car but it was too small for their purposes and therefore was disposed of. There are, however, some fifty Diesel-electric cars owned and operated by small private roads in Sweden which are reported as giving good service. The State Railways are now trying out a 300-hp. Diesel electric locomotive, reported as performing satisfactorily. The inspection of this car showed that its about 40 ft. in length and aside from an 8-ft. baggage space is all power plant. The engine was being overhauled at the time of inspection.

Railroads need secondary motive power

I feel that what the railroads need is a secondary power, something between their small standard locomotives and the light weight self-propelled cars. Whether such a car will take the form of the internal combustion engine or steam is still a matter to be determined. I feel that in cars of 500 hp. it will be possible to develop a steam car that will compare favorably in efficiency with the internal combustion type and would not require the building up of a special personnel for their maintenance. Steam has proved a very reliable source of power for railroad transportation owing to its flexibility.

Since Watt, over 100 years ago, called R. A. Trevithick a potential murderer for proposing to operate boilers at the dangerous pressure of 60 lb. per sq. in., every subsequent increase in steam pressure was opposed by the conservative majority, and it was not until our electrical friends demanded something more efficient in the way of high speed for their purposes than the existing steam engine as a prime mover, that the steam turbine was developed to meet this demand. The steam engineer, owing to established precedents, opposed higher speeds and high pressures. Electrical engineers, on the other hand, not being tied up to so long a line of precedents were more progressive and the steam people were forced to meet their demands. I think I still notice in this country among steam users, objection to high rotative speeds in turbines. European engineers seem to have pushed ahead of us in this respect.

The same feeling existed as far as the boiler was concerned and high pressures were looked at with alarm, but the increase in boiler pressure has gone on until now 500 lb. and more is accepted. We have now reached the point of giving serious consideration to the Benson super-pressure boiler. In this boiler it is proposed to generate steam at a pressure of 3,200 lb. at a temperature of 706 deg. F. An experimental plant has been constructed at Rugby, England, which it is expected will be in operation about the first of the year. A 50 per cent interest in the boiler has been disposed of to the firm of Siemans & Schuckert, German, and the latter company has erected a 2,000-kw. plant at Berlin for experimental purposes.

Regardless of whether the prime mover is a gasoline engine, Diesel motor, or steam turbine, it is very important that the transmisison between the prime mover and the secondary shaft be of such flexible character that it will not transmit shocks and jars from the track to the prime mover. This is so thoroughly recognized by railroad men and builders of locomotives and motor cars that probably more attention is being given it today than the type of prime mover. I found that they are not only building various kinds but any number of projects are in the air. Unfortunately many of them fail to get down to earth.

(Mr. Finley here described in some detail several of the important transmissions offered to date including hydraulic (swash plate, Lentz, and Fottinger); semi-hydraulic (Schneider hydro-planetary and Sim); and several miscellaneous transmissions including the Entz magnetic, Constantinesco torque converter and the De Lavaud which imparts its motion to the driven parts through ratchets or a variation.—Editor.)

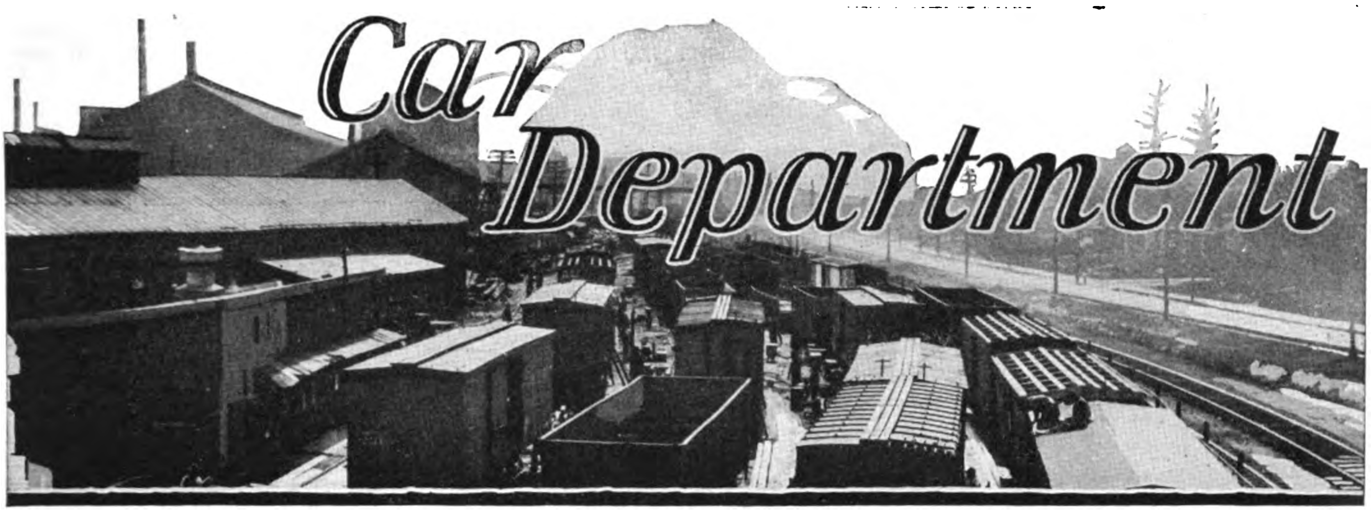
We have been told, from time to time, that the steam locomotive would be scrapped in favor of some new form of power, but it is still doing good and reliable work for the railroads, and will continue to do so for many years to come.

I believe, however, that improvements can and will be made that will greatly increase the value of the steam locomotive for transportation purposes. I believe that some of the power on the railroads can be greatly improved by the addition of a low pressure steam turbine tender, adding greatly to the tractive force without any additional fuel consumption and thereby making unnecessary the purchase of heavier power.

I believe the next improvement will be in the use of higher pressure steam and with a tender carrying a low pressure turbine, or possibly the combination in one unit of a high pressure piston locomotive and steam turbine. I believe these improvements will come in the immediate future.

Assuming that the Benson super-pressure boiler becomes a commercial success, I can vision the operation of railroad terminals, and even suburban trains by fireless locomotives with steam furnished from highly efficient super-pressure central stations, thus eliminating smoke, dirt and noise. This will save railroads the large expense that electrification would entail.

The Interstate Commerce Commission has denied a petition of the Louisville & Nashville that it be relieved of complying with the second automatic train control order of the commission until it has had time to determine the results of its first installation, but has postponed the effective date of the order from February 1 to July 18.



Methods of cleaning the interior of freight cars

SHIPPERS of grain, flour, sugar, rice, fruit, and food products of all kinds naturally demand cars that are free of all odors, and cars whose floors and walls are neither greasy nor oily. Even shippers of rough freight are becoming more and more particular as to the condition

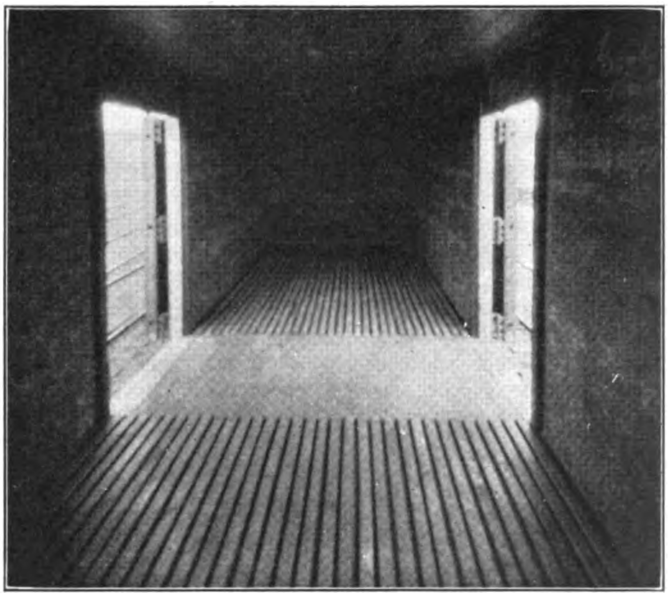
Brushing out a car after it has been rinsed with water

of cars furnished them for loading. The advantage to be gained by the railroad that fully meets these demands is obvious.

Formerly, two general courses were followed in refitting greasy and smelly cars. Many such cars were refloored and fortunate has been the foreman who could report a hundred dollar average for each reconditioned car. Or in some cases, particularly those involving smelly cars, sulphur or lime or a combination of both has been used to combat the offensive condition. The two objections to this latter system are that frequently the smelly condition was not improved, and that where improvement was obtained, many days were required, which when figured into the cost of cleaning made this figure exhorbitant.

To remedy these conditions it was but natural that cleaning methods should swing to the other extreme, and in place of being too crude to be effective the methods next devised were too detailed to be efficient, and so much costly equipment was needed that the working costs were raised beyond the limits of economy.

Today, extremely greasy and smelly freight and refrigerator cars are cleaned in two to four man hours and immediately after drying are loaded with food products. The cost of doing this work totals but a few dollars per



The car has a cleanly, tidy appearance after the oil and grease have been removed

car, a $3.00 average being in no way unusual. Further, the equipment necessary for such work is neither costly nor extensive as it includes a broom, a sprinkling can, two buckets, a hose line, a squeegee and two wire brushes.

The dirt to be removed from freight and refrigerator cars is of three kinds: general rubbish, oil and grease, and

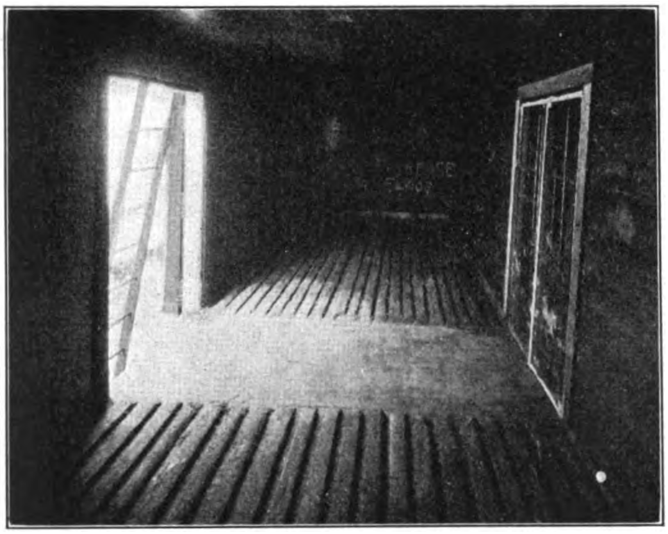
those materials leaving odors. Ordinary sweeping and washing methods will satisfactorily remedy only the first of these conditions.

Methods of cleaning oily cars

Oily or greasy cars should first be swept dry throughout. Then, using an ordinary sprinkling can, apply a solution of a prepared metal cleaner, such as is used in the shops cleaning vats, to all oil or grease spots or, in very dirty cars, completely cover the floor. Let this solution stand about ten minutes, but do not allow it to dry out. Then scrub with wire brushes as shown in the accompanying illustration, and thoroughly rinse out the car, using a hose line if available.

The cleaned cars will dry out much faster if excess water is pushed out with a squeegee. After the car is dry the floor will be clean, free from grease, and immediately available for loading freight of any kind.

The cleaning solution used in washing oily and greasy cars is prepared in the following manner. Put from four to seven pounds of metal cleaner in an ordinary pail and add about three gallons of water. The exact amount of cleaner to be used depends upon the condition of the car to be cleaned. When available, some time will be saved by using hot water in making up the solution. When a number of cars are to be cleaned it is advisable to make up in barrels 50 gal. of solution. The solution should be stirred each time before using.



A refrigerator car with oil and grease on the floor

As the average car can be cleaned with from four to seven pounds of metal cleaner, and as the cost of the cleaner is but a few cents a pound, material costs per car are very low. The class of labor doing this work probably is paid $.40 an hour, and since it is not unusual for two men to average eight or nine cars in a nine hour working day, labor costs are reasonable.

Method of removing odors

Cars with strong odors are cleaned in a somewhat similar manner, but using a sanitary cleaner instead of the metal cleaner used when washing oily and greasy cars. This is also an alkali but of different composition and of far less strength than metal cleaners. The principle on which it operates is not that of displacing one odor with another but of completely removing their cause, giving a sweet smelling, odorless condition.

Smelly cars should first be carefully swept dry, brushing down the walls and ceiling, and cleaning out all the crevices. Then thoroughly flush the car with water, and again sweep out. Where cars are equipped with floor racks these should be removed and cleaned separately. Cars equipped with ice bunkers should also receive special attention as the bunkers are frequently an ideal storage for bad odors.

While the car is still wet, sprinkle the interior with the dry sanitary cleaning material and let it stand for about ten minutes before scrubbing.

Then using a solution of one pound of the sanitary cleaner in a three gallon pail of water, scrub the interior of the car with brooms. Especial care should be given all corners and cracks. After scrubbing, rinse the car well and to hasten drying, push out the excess water with a squeegee. When the car is dry it will be found to be thoroughly clean and odorless, being immediately available for loading all kinds of food products.

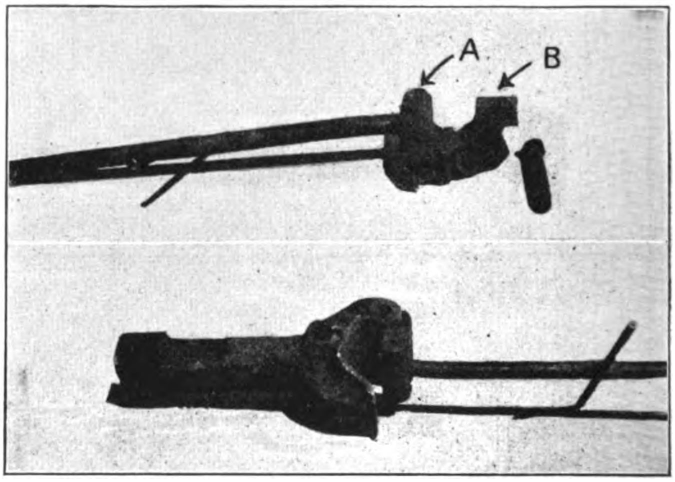
Where the cars are both greasy and smelly, first clean with the metal cleaner solution, and after rinsing, clean a second time with the sanitary cleaner and cleanser solution. Cars that are especially smelly should be cleaned with a somewhat stronger sanitary solution than outlined above, using three pounds of the sanitary cleaner instead of one in the scrubbing solution and also allow the dry powder to remain on the wet floor 15 or 20 min. before starting the scrubbing. Ordinarily smelly cars will require but 10 lb. of the sanitary cleaner, while especially bad cars may require from 15 to 20 lb.

Device for holding car couplers in a blacksmith's fire

By J. Robert Phelps

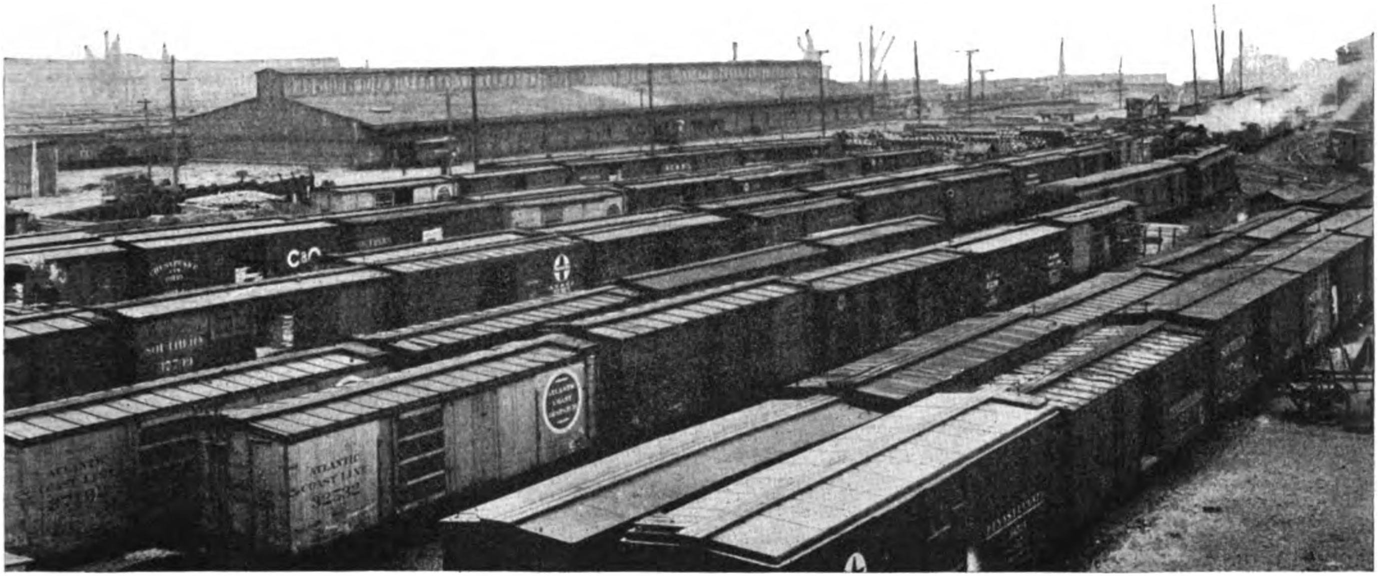
Apprentice instructor, A. T. & S. F. shops, San Bernardino, Cal.

A CAR coupler is an awkward piece of work for a blacksmith to handle when straigntening it in a forge fire. The device, shown in the illustration, designed by J. Wyler, general blacksmith foreman, provides a means of handling couplers with comparative ease. A hole is drilled in a coupler knuckle at point *A* in which is inserted an iron bar. An electric weld is placed around the bar where it enters the knuckle, the purpose of which is to prevent the bar from working out. A small iron block is welded on the coupler knuckle at point *B* to prevent it from opening when it is placed in the coupler.



The top view shows how the handle A and block B are welded to the knuckle; The lower view shows the knuckle in the coupler

When the blacksmith has a number of couplers to heat and straighten, he uses this knuckle in each coupler, holding it in place with a knuckle pin. A chain can be placed around the bar for supporting and balancing the coupler.



Systematic preparation of A. R. A. billing and records*

By Livingston Martin

Chief accountant, A. R. A. Bureau, B. & O., Baltimore, Md.

CAR repair billing, on account of the high cost of labor and material, has assumed such proportions in the maintenance of equipment costs that it is decidedly important that it be handled in a systematic manner with the least cost essential to full protection of the railroad companies, and the proper handling of this item will assist the management of the railroads in the reduction in operating expenses.

The American Railway Association Interchange Code of Rules is divided in three classes: interchange, maintenance and billing. The billing rules are so closely linked to the interchange and maintenance rules that it is not possible to obtain efficient billing without a thorough knowledge of all the rules; therefore, it is the duty of the billing bureau to check interchange and maintenance as well as billing.

In checking interchange, let me suggest that your traveling man periodically visit your large joint interchange points, check the repair records and take note of all the delivering line defects repaired and compare them with the joint interchange records to see who delivered the car and whether or not defect card was issued. In this way you will determine if your local people are making proper claims for protection. If you find they are not, test your foremen and inspectors to see if they are familiar with all delivering line defects and impress upon each individual the losses sustained by the company through improper protection at interchange points. The Joint Interchange Inspector will issue the defect cards whenever the necessary data and a chance to examine the condition is furnished him.

Small outlying interchange points can be checked in the same manner by visiting the nearest repair shop in line with the movement of traffic and comparing the repair and inspection records. Similarly, the operation of shops can be checked to determine if your supervision is running cars received in interchange with delivering line defects without making repairs by listing the defects from the interchange records and comparing them with the repair records.

Some joint interchange inspectors will not issue defect cards for many items of handling line defects unless it is shown that repairs were made and a check of the shop records on line will very often reveal the amount of losses sustained by the company in running cars with delivering line defects. Bear in mind, delivering line defects must be repaired before the car leaves your line and the company who runs cars away from interchange points or nearest shop thereto with delivering line defects that have not been carded pays double the cost of making the repairs later.

It is expensive practice to shop cars for repairs at any point and run them without making the repairs and if you will examine your inspection records at repair points and follow the movement of cars over your line, you will find this practice is being indulged in to some extent and cars are being shopped two or three times at different points for the same defects, until the condition becomes such that repairs must be made; in the meantime, the delay to shipment, switching and per diem costs has far exceeded the repair costs.

Issuing defect cards

From the manner in which a great many defect cards are issued, I do not believe that all inspectors realize the importance of correctly writing defect cards, or that they are issuing the equivalent to a check on the bank account.

It is not uncommon to receive defect cards in the bill-

*Abstract of paper presented before the twenty-fourth annual convention of the Chief Interchange Car Inspector's and Car Foremen's Association of America, held at Chicago, September 22, 23 and 24, 1925.

ing bureau with the station, date, location of defects, sometimes name of inspector, left off, defects jumbled up from end to end, to roof, to trucks, to sides, to ends, etc., indicating that the inspector kept walking around and climbing over the car until he finally got all the defects listed on the card and when finished, the defect card resembles a scrambled egg—you cannot distinguish the white from the yellow. It is the bill clerk's job to check the bills received on such cards and I believe you will readily understand how impossible it is for him to do so properly with information furnished in that manner.

Issue defect cards in a plain legible hand, written on both sides in accordance with the rules so that at least one side of the card will be legible when removed from the car and forwarded to the billing bureau, list all defects, particularly on specially constructed cars such as: refrigerator, chicken, tank, etc., for which the handling line is responsible, and eliminate, as far as possible, the necessity of bill clerk having to decide if additional items charged for, not shown on the defect card, were necessary to repair the items shown on defect card, segregate the damages as to location and show the location of defects on car in accordance with A. R. A. Rule 14, which will enable the bill clerk to see in his mind's eye the defects as they existed on car, and you will remove some of the items of grief that come into the bill clerk's daily life.

In order that the bill clerk may have an opportunity to correct irregularities in issuing defect cards, a copy of each card issued should be immediately forwarded to the billing bureau, which will enable him to call to attention any irregularities in issuing defect cards and at the same time educate the individuals in the proper issuing of cards. Receipt of copy of defect card also enables the billing bureau to check the location of the car through the car service department to see that defect cards are not erroneously issued against the company and permits them to make any special investigations, such as wrong wheels, without waiting for receipt of bill from repairing road.

Avoid making wrong repairs as far as possible by applying A. R. A. standard material and framing timbers to proper size, in accordance with the owner's standards and A. R. A. practices. For owner's protection, defect card must be attached to car at the time and place wrong repairs are made and for handling line protection the defect cards must be marked "labor only" when they involve material not listed in Rules 88 and 122. Making wrong repairs is expensive in that the bill you render is usually more than offset by the bill you receive for correcting wrong repairs.

With the exception of cast iron in place of steel wheels, wrong repairs are not cardable in interchange; however, interchange inspectors, as well as all other inspectors, should look for wrong repairs and attach joint evidence card to car, as joint evidence card is not valid unless signed within 90 days of first receipt of car on home line. Correction of wrong repairs must be made within nine months of first receipt to justify the bill on the defect card.

All other defect cards are outlawed two years from first receipt and they should be watched closely to see that repairs are not delayed beyond the two year period.

Original record of repairs

It is useless to say that the prescribed A. R. A. forms should be adopted as nearly as possible on all railroads. The Supplementary Regulations, effective January 1st, 1924, detail the manner in which these records must be compiled, as well as some of the information that must be shown, in order to collect for repairs made and if you are not following out those regulations in preparing your records, you are not complying with the A. R. A. rules.

It is desirable, from a shop operating standpoint, to inspect and write the original record of repairs as soon as cars are placed on shop tracks, as it furnishes a guide for the workmen and often saves time as it is not always possible for the foreman to be on hand to explain the work to be done as the men advance from one car to another.

The prescribed Form "F" shows the general minimum information that must be shown on the original record of repairs. In addition I believe the form should require the date the car was built, light weight, loaded or empty and kind of trucks, as these items often govern the charges to be made and aid in checking repair records. The date built also establishes the standard to the car in the case of triple valves and couplers.

It is also necessary that the party writing the original record determine the responsibility for repairs. Where a car has both the handling line and owner's defects, the repairs should be segregated under each heading. It should also be shown if temporary or wrong repairs were made and if defect card was issued. When repairs are made on authority of defect card, notation showing name of road and date card was issued should be made. The latter information is important in tracing for lost cards, as well as defending bills for handling line defects. It is my suggestion that above information and repairs be segregated on the original record under the headings: Owners Defects, Owners Defects—Wrong Repairs, Owners Defects—Temporary Repairs, Handling Line Defects, Handling Line Defects—Wrong Repairs, Handling Line Defects—Temporary Repairs, Authority of Defect Card.

Do not specify nuts used with removal of bolts, but any additional nuts not used with renewal of bolts should be entered on record as a separate item. Some roads use unit nuts in lieu of common nuts and these should be specified whether or not used in renewing of bolts. The kind, full dimensions or actual weight of castings, forgings, structural and pressed steel shapes must be shown on record. I favor reporting dimensions on all regular size material over actual weights furnished by the shop people, as I believe more uniformly correct charges will be made therefrom, besides it furnishes a basis for the party receiving bill to check weights. While the rules only require "new" or "second hand" shown for certain materials, I believe it good practice to show this information for all material, as it creates habit in showing kind.

The party making final check of the original record with repairs made to car should establish the following facts and complete the record before he attaches his signature:—

1—Are all repairs shown on the record properly made?
2—Were any additional repairs made that are not shown on record?
3—Show kind of material applied.
4—See that all other information required by the rules is properly shown.

The correct foundation for car repair billing, therefore, depends on your educational system and I believe better results can be obtained through personal contact than by any other method. I am not in favor of educating clerks at the repair points to relay the information to the man on the shop tracks. I am in favor of educating the men who write the original record and believe the responsibility for educating the men to prepare correct records should be placed on the traveling men, thus establishing a direct connection between the billing bureau and the men who write the records. For the purpose of keeping the traveling men posted as to conditions in their territory, let the billing bureau return all irregularities in records direct to the traveling men whose duty it is to call on the individual responsible for the irregularities and explain to him his error, and show him how the

record should be prepared, pointing out the specific rules governing the case, at the same time allow him to correct record in accordance with supplementary regulations. If you have a man who will not improve under this method of education, then you have not the right man on the job, and there is only one remedy, remove him. It is expensive to educate the men for work checker jobs, therefore, they should be kept on the job as far as possible, except when promoted. It has been said before in this meeting that a car foreman or car inspector who does not know the A. R. A. rules is an expensive man to the railroad and I want to add that the work checker who does not know the rules is also expensive; therefore, educate your work checker and in doing so you are building up an organization from which to select your future car foremen or other supervision.

In accordance with supplementary regulations, the traveling men should make surprise checks on shop tracks for protection of both the owner and handling line, by arriving on the shop tracks at the closing hour and checking the original record with the repairs made to cars.

I am not in favor of having the traveling men spend their time in the office checking repair cards with original record, as I do not believe it pays financially, in fact, that class of check can be done with much cheaper labor, but I am in favor of the traveling men spending their time on the shop tracks and in the transportation yards, checking up the class of work performed as well as the records and assisting those doing the work and making records wherever possible.

I am not in favor of voluminous reports of each minor irregularity from the traveling men to the higher officials and which later come back with a jolt that destroys the good will of the shop forces, but I am in favor of the traveling man working out the conditions and correcting the irregularities on the ground and making his reports only when the local people will not improve under his instructions.

Hold the traveling men responsible for the conditions and you have a positive check in your building bureau on the condition, in the number of records you are compelled to return for correction.

The supplementary regulations state that no erasures are permitted on original records and corrections must be made by drawing a line through the wrong information and rewrite the correct information; however, I am not in favor of wholesale corrections for the reason that unless the car is still in the shop, with few exceptions, corrections are made from memory and are, therefore, classed as assumptions.

For the purpose of securing uniform records, the Baltimore and Ohio adopted a code of symbols for showing kind of material, cause for repairs and location of repairs, which are as follows:

A—Accident Rule 32.
B—Broken.
BA—Broken due to accident according to Rule 32.
BD—Broken due to decay.
BT—Bent.
BW—Broken and welded.
BU—Burst.
BS—Burst in seams.
D—Decayed.
L—Loose.
LK—Leaky.
M—Missing.
OP—Out of place.
ST—Stripped threads.
WO—Wornout.
NA—New material applied.
OA—Second hand material applied.
R&R—Removed and replaced same material.
RSR—Removed, straightened and replaced, same material.
S—Straightened.
SC—Straightened on car.
A—A end.
B—B end.
AL—A end, left side.
AR—A end, right side.
BL—B end, left side.
BR—B end, right side.

The above symbols, together with the regulations for originating original records as covered by supplementary regulations, are printed on the back of our original record forms and we require each individual to use them in preparing records, which insures a uniform record from all stations, saves time of the work checkers in writing records, insures full complete information in all cases, saves time of the clerks reading records and reduces to the minimum errors in rendering bills.

Get the foundation correct and all else is easy.

Handling accident cars

The determination of responsibility for repairs to extensive damages on foreign cars is of such importance that it should be especially handled by the supervision in the car department and billing bureau for the protection of both handling line and owners.

A. R. A. Rule 32 furnishes the dead line and any damages occurring under the provisions of that rule should be plainly marked on all records pertaining to car repairs. In case the two inspectors do not agree as to responsibility, the car foreman should render final decision.

Copies of all accident reports on the division should be forwarded to the car foreman and complete file maintained in the car foreman's office. I would suggest that the accident reports be filed in a loose leaf binder, properly indexed according to car numbers. In case accident cars are moved from one division to another for repairs, a copy of accident report should follow the cars. Before records or billing repair cards are forwarded to the billing bureau, they should be compared with the accident file to guard against improper charges. In case the division people subsequently learn of any errors in marking responsibility on records or repair cards, they should immediately notify the billing bureau to make adjustment.

As a further precaution against charging for accident repairs, the wreck master should forward a copy of all accident reports direct to the billing bureau, who should check with the bill files and make adjustment in all cases of erroneous billing.

Where accident reports do not show sufficient detail to properly determine responsibility for repairs, it is the duty of the billing bureau to thoroughly investigate the conditions surrounding the failure before rendering bill and place the responsibility accordingly.

Many roads use the accident forms in reporting disciplinary cases to the transportation officers and where this is done, diligence on the part of the billing forces is necessary to see that charges are not marked "accident" where the damages do not occur in accordance with the provision of Rule 32.

Handling of destroyed cars is another item that should receive the personal attention of the supervision as it is an easy matter to throw away $500 or $1,000 on a car through not handling it according to the provisions of A. R. A. Rules 43 and 120.

The A. R. A. rules do not place any limit on the owner's responsibility so long as the damages are not caused by any of the provisions of Rule 32, therefore, carefully prepared estimated costs of repairs, per A. R. A. prices, should be made on all extensively damaged cars to determine the most economical disposition to be made. Very often accident cars can be repaired and restored to service at considerable less cost than the depreciated value. Only such cars as are damaged under the provisions of Rule 32, or on which you are unable to furnish statement as per Rule 43, should be handled under Rule 112. I am afraid that a great many carmen are overzealous in getting rid of damaged cars and destroy them under Rule 112 without giving the owner an opportunity to inspect them in accordance with Rule 120, with the

result that the handling line pays depreciated value on owner's defects when they should be reimbursed for labor cost of dismantling car.

When estimating the cost of repairs be sure that all items are fully covered according to A. R. A. prices, as bills for repairs will be accepted for only $50 in excess of the estimate. For the purpose of securing correct estimates, the shop people should list in detail, all damages in the same manner they prepare records for billing. The estimate should be priced and completed by the billing force.

Handling of transfer and adjustment and door protection bills

As a general proposition, this item is not being hantend that it has no connection with the Interchange Rules dled by the car repair billing forces. Some roads conand should be handled by the transportation forces under the Accounting Officers' Association Rules. In this, I do not agree for the following reasons:

1—It is authorized by Interchange Rule 2 and Car Service Rule 14, whicl is made a part of Interchange Rules.
2—The work in the large majority of cases is performed by car department employes who furnish the information for billing.
3—Supplementary regulations recommend that all matters pertaining to Interchange Rules be handled by the billing bureau.

On account of the billing bureau's familiarity with the rules as well as road conditions, I favor the handling of transfer and adjustment bills by the billing bureau and believe that considerable savings can be made by handling them in that bureau, particularly if the bureau is equipped with traveling men through which to make investigations.

As far as checking debit bills for this work is concerned, there is not much that can be done as they are rendered on the actual cost basis, however, your home records should be investigated to see that all costs entering into this work are billed for.

Copy of each authority issued for transfer and adjustment of lading should be forwarded to the billing bureau for investigation as to movements of car. You will find many authorities issued account of old defects, where the car service records show the cars coming from connections, indicating that the inspection at connections is lax.

In other cases you will find bad order cars loaded on home line. All such cases should be taken up with the proper operating officials as the greatest saving to be had in handling this item is to prevent the necessity of transfer and eliminate freight claims.

The item of inside door protection should be handled in the same manner with a view of having the shippers properly load cars in accordance with loading rules before accepting them for movement.

The importance of systematic methods

The most important factor in handling any business is system and you will pardon me for referring to my personal experience with three different systems for handling car repair bills, as I feel that some benefit may be derived therefrom by the members of this organization in improving the systems on their respective roads.

Under the first system, the complete bill was rendered at the repair station; that is, the billing repair cards were written, priced and listed on bill forms and the complete bill was forwarded to central office where they were consolidated under one recap. and forwarded to the various railroads.

The principal objections to this system, outside of its high cost, was lack of uniformity in charges as it was practically impossible to keep highly trained price clerks on jobs scattered over thousands of miles, lack of supervision, account of which many heavy repair charges which the clerks did not know how to price, found their way to the waste basket, endless correspondence with the division people, as all records were filed at repair stations and with railroads in adjusting errors in bills. Under this system, the Baltimore & Ohio ran a monthly debit account in foreign car repairs of from fifty to one hundred thousand dollars.

Under the second system, the billing repair cards were written at repair points and forwarded to the central bureau weekly where they were assorted for ownership, priced and listed on bill forms to railroads. This system eliminated the necessity of maintaining price clerks at repair stations and made possible uniform charges and credits in rendering bills and reduced to the minimum wilful destruction of bills, but it did not reduce the cost of handling bills or the correspondence with the division people, but that correspondence was now carried on before bills were rendered and forwarded to owners. The efficiency of this system over the first system was apparent when the monthly foreign car repair account changed from debit to credit.

Under the third system, all clerks writing billing repair cards were removed from the repair points and the whole clerical force engaged in rendering car repair bills is consolidated in one office. Original records are issued in duplicate by aid of carbon, the duplicate is filed at repair station and the original is forwarded to the billing bureau daily. System car repair records received in billing bureau, except those on authority of defect card, are filed on receipt, while foreign car and authority of defect card records are counted and turned over to the bill clerks to prepare bill.

The bill clerks write and price billing repair cards as per A. R. A. rules in one operation and a record is kept of the number turned out by each clerk per day.

In case additional information is necessary before bill can be rendered, the original record is returned to the traveling man located in the district and he personally takes up and explains to the employee originating the record the necessity for furnishing it. The original repair cards move on to the assorting desk where they are assorted into ownership and arranged in bill form. From the assorting desk they move to machine operators who list them in duplicate on bill form and complete bill. The completed bill passes to the audit clerk for audit and is immediately mailed on completion, while the duplicate bill is held and listed on the shop report at the end of the month, from which the record is placed in the ledger for collection. The first figures of audit number represent the month's account (1006 January account, 12006 December account). Duplicate bills are filed in binders, the backs of which are labeled Audit Number from — to — inclusive, which not only keeps file in first class shape, but also insures ready location of any bill.

Duplicate copy of repair cards for shop track repairs, together with any additional information that it was necessary to secure from repair station before bill was rendered, is attached to original record and filed in 1,000 pocket cases according to last three figures of car number. Notation showing serial number of original record is made on transportation yard repair cards and the repair card is filed according to last three numbers of car, while light repair and inspection records are filed by stations in date order.

Foreign road bills are checked and vouchered in a central billing bureau. Exceptions to charges are written on the back of the billing repair card and turned over to a stenographer who writes a letter to the party rendering bill. The checking is performed by the same clerks who render system bill. This practice is desirable on account of the education it furnishes in allowing clerks to see what

other roads charge and it tends to make uniform practice and charges in rendering and accepting bills.

All correspondence, answers to exceptions, are handled by the supervision of the office and any irregularities in pricing are called to attention of clerks responsible.

The latter system places in the billing office a complete file of all repairs made to cars, the value of which is apparent to all bill clerks in handling exceptions to bills as well as tracing for wrong repairs, etc. It reduces correspondence with the division people and delays in answering exceptions to the minimum. It removes all inclination on the part of division people to destroy bills as their responsibility ends with the mailing of records to the billing office, at the same time furnishing a complete safeguard aaginst wilful destruction in the billing office. It abolished the entire billing force at division points and relieved the car foreman of all accounting work, at the same time caused a payroll reduction of 50 per cent in the cost of handling bills and produced a higher degree of efficiency on account of closer supervision and the opportunity to educate the billing forces. The general results of the consolidated system have been satisfactory beyond our expectation.

Several railroads have adopted the practice of having the shopmen write combined original record and billing repair card at the car, which eliminates the copy work of transcribing from original record to repair card and will result in considerable reduction in clerical force and cost of handling bills.

This practice is not new as it was in vogue on a number of railroads some years back. The Baltimore & Ohio discarded it on account of the inability to have the men write the records; however, at that time the men were expected to work 10 hours and write up the records after completing the day's work without additional compensation and accordingly a great many records were not written. We are now experimenting along these lines in transportation yards and believe with proper supervision the work can be satisfactorily performed without delay to trains.

From our experience in the use of symbols in reporting information on records, we believe the writing of combined original record and repair card can be more satisfactorily performed by the carmen if the American Railway Association will adopt a code of symbols to be used by all railroads and I would like to see this Association recommend that standard symbols for showing kind of material, location and cause for repairs, be adopted. We believe there is considerable merit in the plan and if the American Railway Association will adopt standard symbols, it will save considerable time of the men in writing and at the same time insure uniform records going to the owners.

Discussion

H. M. Warren (B. & M.): I would like to ask approximately how much territory is covered by each of his traveling men?

Mr. Martin: We have 7,500 miles of road and five men—equally divided.

D. E. Bell (C. N.): We have 11,000 miles of territory. Just a question with reference to comparison of original record of repair card, in putting that into force are the originals made with carbon? In Canada it is absolutely impossible for a car inspector to work with carbons. I might say we are experimenting with comparison of repair card work in one office. The company I represent is the first to put it into force and we are putting it into effect now as soon as I can get around to the various points. At Montreal where the repair cards are being made at the cars the billing of repair cards on shop records is also going into the office and the bill for defects is being attached to the original record and being filed at the point at which it is made. It is impossible for a man in the yard to use carbons, for two reasons: one is the rain, the other is the ice. You understand that for three or four months out of the year it would not do for a man to take his glove off.

C. J. Hayes (N. Y. C.): A number of railroads are using the system billing repair cards, which we term the direct billing system of the car. This system is now being installed on the railroad which I represent and is working out very satisfactorily. We have installed it in the train yard as well as on repair track and in shop. We find that with proper instructions to the men they do not seem to have any trouble in using the carbon. This system enables duplicate copy to be kept at point and original billing repair card forwarded to central office where clerk inserts labor charge cost, net price, etc. We find also that this system reduces considerably the number of cases returned, but you will agree that where a number of clerks are employed in copying there are bound to be a great number of errors.

T. J. O'Donnell (C. I. I. Buffalo, N. Y.): Mr. Martin not only hits the billing repair clerk but he hits the interchange man and the poor inspector. I wonder if he realizes what we are up against to get good inspectors. You cannot get a college bred man to look for defects around the yards, possibly the B. & O. are following up to get good men to write up car records. A man may be a good inspector but cannot write out a defective transfer card as we would like to have them written.

E. S. Swift (Wabash). I wonder with the system of making repair cards and original records at the car, what they would do if we asked for an original record. If we got a bill from the B. & O. and we ask them for an original record what would they give us?

Mr. Martin: We would furnish you with an original copy of the record as made up by the man at the car. It has been my experience that a carbon copy is always the same as the original and I think it would be so considered by the A. R. A.

J. E. Gordon (N. Y. C. & St. L.): Mr. Martin spoke about wrong repairs going on cars but evidently he did not go into it thoroughly for wrong repairs are going on every day. With a foreign car we cannot insist, where a man in a repair yard applies an 8½-in. coupler, that he be compelled to put in 9⅛-in. If he puts in the same kind he should put a defect card on the car for wrong coupler and get blamed only for putting it in. It seems to me that where a car is stencilled for 8½-in. coupler to insist on a 9⅛-in. coupler would be wrong.

Mr. Cheadle: The speaker is either mixed up or I am. I understood him to say that if it comes in for an 8½-in. he would have to put in 9⅛-in. I could put in 9⅛-in. coupler and bill the owner.

Mr. Gordon: Rules do not provide for that; you must put in 9⅛-in. regardless of your stencil.

Mr. Jamison: I have a copy here of a letter written by Mr. Hawthorne who says in answering a similar question that:

> The Arbitration Committee approves the following interpretation of Interchange Rule 101 which will be included in the next supplement.
>
> Q. In the event of applying a coupler of A. R. A. standard type "D" 5 by 7-in. shank except that size of butt is 8½-in. In replacing defective coupler of same size account owner's responsibility what price may be charged for coupler applied?
>
> A. If such coupler is standard to the car it may be charged at regular price for A. R. A. "D" coupler on same size shank.

Therefore in the case of defective "D" type coupler you could still bill the owner, but I presume he has reference to the old style of A. R. A. coupler.

Mr. Smith: I would like to inquire of Mr. Martin the

progress of that copy of the original record and repair card, as we all know there are more than two or three cars on the repair track. I wonder how the man who goes along gets his information and how he puts it down, whether he waits until everybody gets through and then writes it up and how he kept the original record of repairs made to the cars.

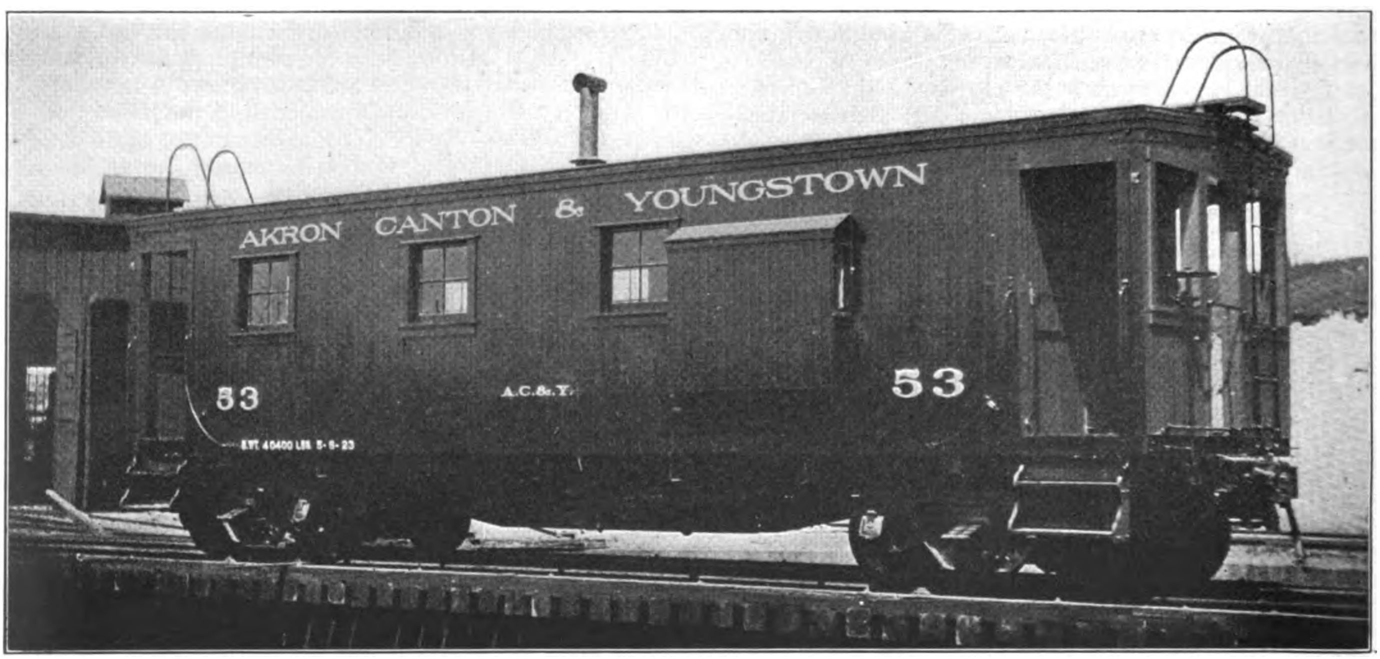
Mr. Martin: We are not writing combined original record and repair card on shop track. We are using A. R. A. standard original record on shop track, because the investigation we made did not show up to our satisfaction, that they were any cheaper. However, in our transfer yards where no light repairs are made, we are experimenting along that line. We are making transfer repairs in triplicate, this is done for the purpose of maintaining a complete file in billing bureau office. Any bill clerk here readily recognizes the advantage of having original record in the office. The advantage is in answering correspondence, because correspondence can be answered the minute it comes in, you go over to the file and readily find your original record. There is no question as to the information on file there, therefore you do not have to go back to the repair station, you do not have to write any correspondence with the foreman, you have reduced the clerk's work and the foreman's work, so far as checking the amount of work done is concerned, to practically nothing.

M. E. Fitzgerald (C. & E. I.): Rule 7 provides that under that protection you must make an original record, no objection to a carbon or any other record but original record must be made first and billing repair card written from it.

Mr. Hayes: This is how the system works out if you use a holder, some railroads use a tin holder, others use aluminum and some have adopted an agosote board which will withstand the elements and is set together by either rings or studs. These boards are prepared in the office by a clerk who places one at every track before the inspector starts, when the inspector arrives at each car he finds the board with repairs to be made marked thereon, one for home cars and one for foreign; the ones for home cars are not made in duplicate, just one copy, if the car is a foreign you have a carbon.

The inspector as he comes to each car picks up the board and notes what it calls for. Such items as bolts and nuts that he cannot determine when he checks the car, are put in later and he shows whether they are renewal or R. & R. The board is taken into the car foreman's office at night and tickets are removed and the top copy for the billing repair card is sent to the clearing house for insertion of labor and material and duplicate is sent into the freight foreman's office and filed. So far as the statement made that this would not serve as original record, I do not see why, because the rules provide that the billing repair card shall be prepared from the original record, and the rules do provide that, but I do not believe that the A. R. A. will ever go on record as turning down a proposition for the railroad when they know there is a big saving involved and we certainly realize that. Now by eliminating the work of transcribing the information from the original record to the billing repair card you have the original record at the car and not made in the shanty, but made by inspector at the car.

The reason for the taking of a strike vote by train and engine service employees of the Texas & Pacific was explained to the Railway Labor Board in Chicago on February 12 by representatives of the Brotherhood of Railroad Trainmen, the Brotherhood of Locomotive Engineers, the Brotherhood of Locomotive Firemen and Enginemen, and of the managements of the Texas & Pacific and the Missouri Pacific. The employees maintained that agreements between them and the management of the road had been violated through the operation of Missouri Pacific trains by Missouri Pacific train crews over the line of the Texas & Pacific between Alexandria, La., and New Orleans. According to testimony of representatives of the railways, joint operation of the Texas & Pacific with the Missouri Pacific had begun in 1916 and had not been seriously protested until 1923. It was also pointed out that while present officers of the labor organizations now oppose such operation, previous officers had conceded to the Missouri Pacific the right to operate its trains with its own crews on joint tracks.



Side bay caboose used on the Akron, Canton & Youngstown

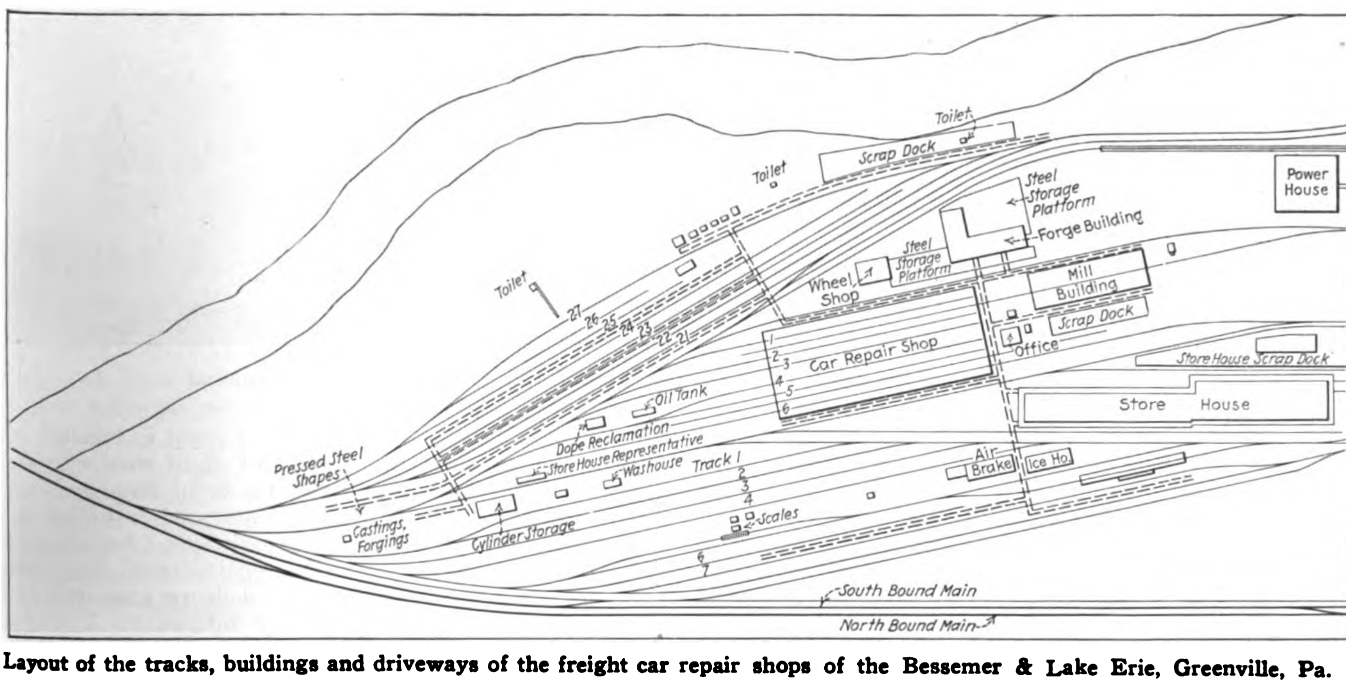
View of the West Yard—The limestone driveways are kept clear of material to permit free passage for the tractors and trailers

Repairing freight cars by the progressive system

Efficient handling of material and gang organization facilitate production on the B. & L. E.

FOR a number of years the Bessemer and Lake Erie has been repairing freight cars at its principal car repair point, Greenville, Pa., by the progressive system. Since the installation of this system a number of improvements and refinements have been introduced, especially in the method of handling scrap and new material, and in the organization of the repair gangs.

These shops are required to handle the heavy repair work necessary to maintain approximately 15,000 cars. The Bessemer has approximately 32 different classes of open-top cars of all-steel construction designed primarily for carrying iron ore, limestone or coal, and in addition quite a number of flat, composite, box, stock and refrigerator cars of which there are about eight different classes. It is the practice of the car department, whenever possible, to schedule one class of open-top and one class of closed



Layout of the tracks, buildings and driveways of the freight car repair shops of the Bessemer & Lake Erie, Greenville, Pa.

cars through the principal repair shops at Greenville, Pa., at a time.

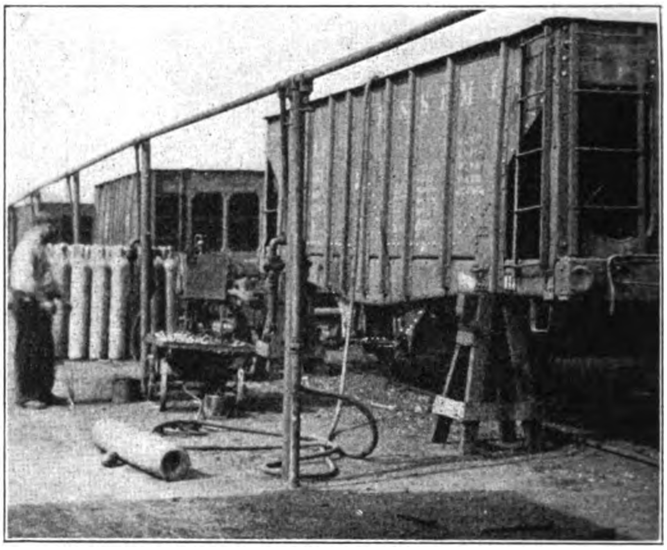
Referring to the layout drawing, box car and caboose repairs are handled on track No. 1 of the car repair shop building, which has a capacity of 48 cars. Located adjacent to this track is a material track which runs directly through the wood mill, tracks Nos. 2 to 6 inclusive are used primarily for repairs to composite and closed cars having wood superstructures. These tracks, however, are also used at times for open-top cars of all-steel construction. Tracks Nos. 25 to 27 inclusive are used for the storage of cripple gondola and hopper cars while tracks Nos. 21 to 24, inclusive, are used for the repairing of all-steel hopper and gondola cars and have a capacity of 55 cars.

The part of the yard in which these tracks are located is known as the West Yard. A total of 176 men are employed in this yard which has an output of one car per hour or eight cars per day. A total of 90 men are employed in the shop building which has an output of 4½ cars per day. Tracks Nos. 1 to 7 inclusive are located in the East Yard, of which track No. 1 is used as a material track, track No. 2 for light repairs and Nos. 3 and 4 for the storage of cripple box, stock, refrigerator cars, etc. Tracks No. 6 and 7 are used for the painting, stencilling and testing of repaired cars of all classes. The scales for weighing are located adjacent to track No. 5.

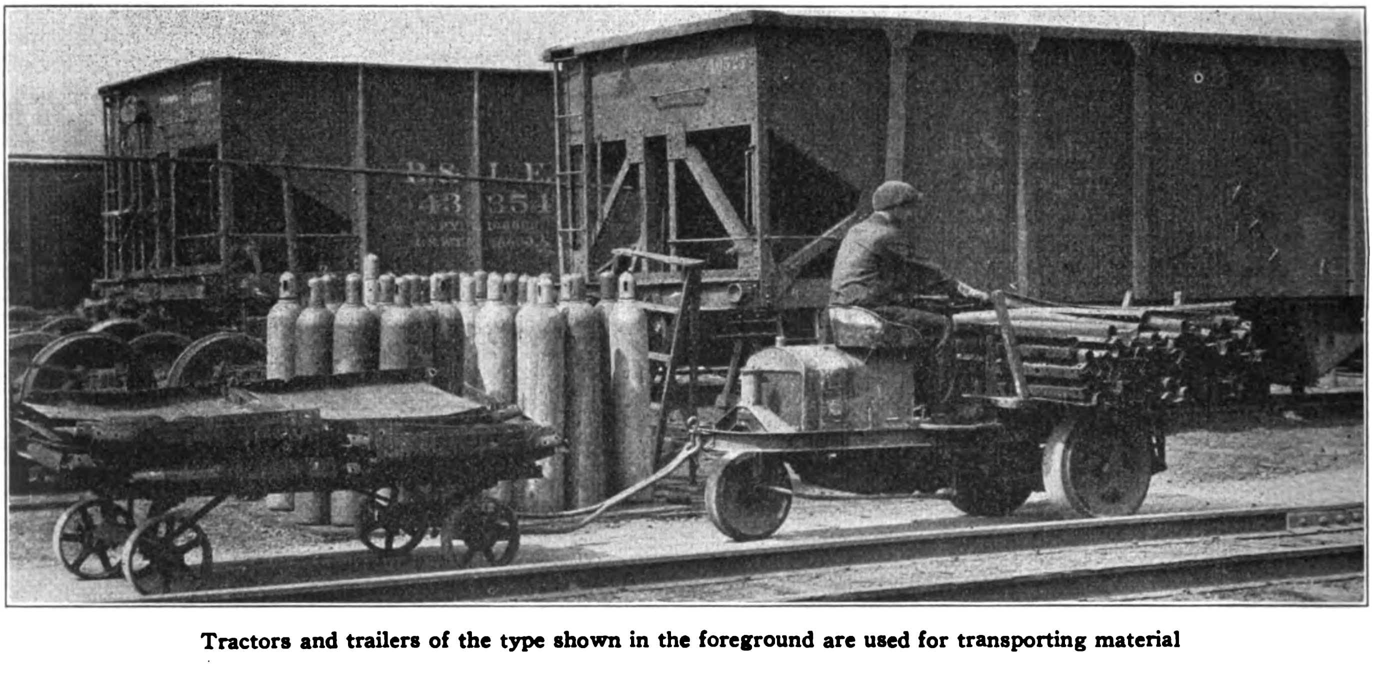
System of handling new and scrap material

The feature of the car repair work at the Greenville car shops is the system in use for handling scrap and new material. A progressive system of car repairs, of course, requires an efficient system for handling material in order to function properly. The success of the system is due primarily to an effective liason between the car and stores departments. A representative of the stores department has an office located near the south end of the car repair yard through whom all requisitions for material are cleared.

A system of limestone driveways, shown by parallel dotted lines on the drawing, is laid out strategically throughout the yard for the operation of gasoline tractors and trailers. Referring to the layout drawing of the car repair shops and tracks, provision has been made for the storage of pressed steel shapes, castings and forgings and also acetylene gas cylinders at the south end of the yard. Driveways extend from this point through the West Yard to a scrap dock which is located west of track No. 27. This scrap dock handles all of the scrap coming from the West Yard. Another scrap dock is located east of the wood mill which handles all of the scrap coming from the car repair shop building and the tracks directly south. The main scrap dock is located adjacent to the storehouse at which point most of the work of reclamation is performed, the other two scrap docks being used primarily for sorting. The work of collecting scrap is handled by tractors and trailers with a crew of eight men who are under the supervision of the general scrap foreman.



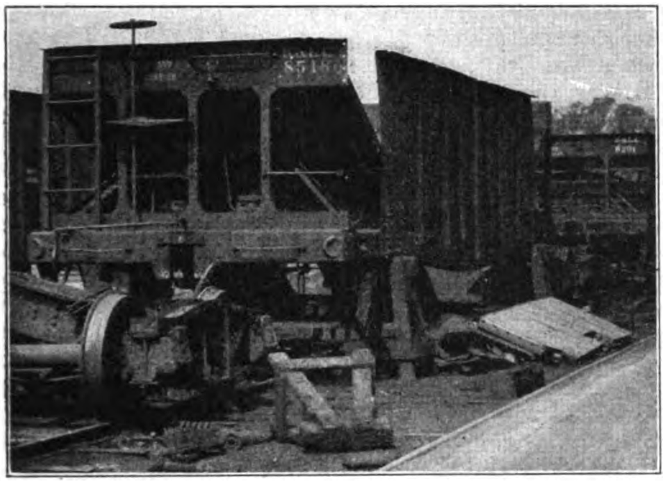
The equipment for each gang is designed so that it can be easily moved from car to car—View showing a car body on which a rivet gang is working



Tractors and trailers of the type shown in the foreground are used for transporting material

The car repair work in the West yard is under the supervision of a foreman and two assistants. An assistant foreman inspects each car to be repaired and marks the parts for repair or renewal. The delivery man who has charge of the delivery of material follows the assistant foreman as he inspects the cars and records in an order

book the number of the car, and the items of material required. As soon as one track has been completed the delivery man turns the order book in to the stores department representative, who has charge of six men who load the material required on trailers stationed at the material docks located at the south end of the yard. The tractors



Adequate transportation facilities are provided for removing all scrap material from around each car as soon as it is thrown out, the only material left is that which goes back on the car

which operate under the supervision of the delivery man, then take the loaded trailers and deliver the material directly to the cars.

Orders for material kept in the storehouse building are handled by telephone, the telephone order forms being filled out from the shop clerk's order book, of which there are a number in circulation. Through the operation of this delivery system, the stores department has supervision over all material until it is placed on the trailers to be delivered by the car department directly to the cars.

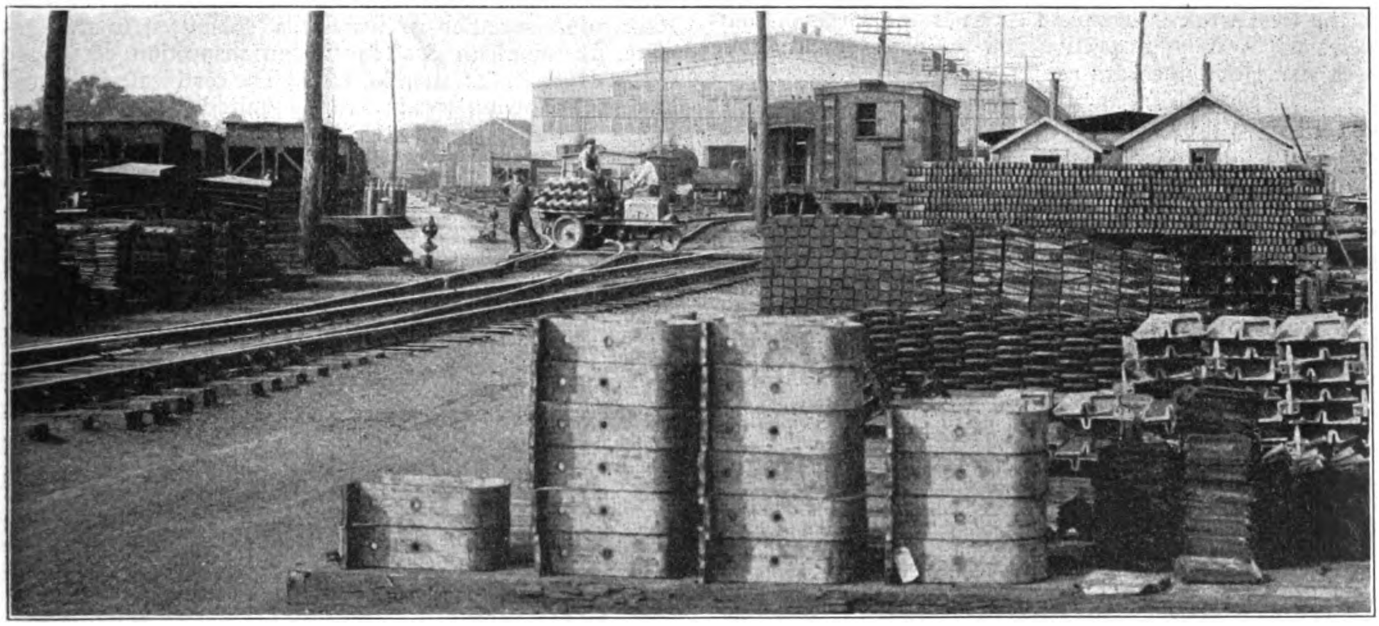
The cars are jacked up by a gang of four men who go along each track ahead of the assistant foreman who inspects the cars. The assistant foreman who does the inspecting is also in charge of the gas cutters and gangs who cut the cars down. The work of gas cutting is performed by one man, who is followed by a gang of four men who back out the rivets, throw out the sheets and make the cars ready for the fitters. After the make-ready work has been completed a gang of fitters in charge of the other assistant foreman fit all the parts together by means of key bolts, as shown in one of the illustrations, ream the holes, and prepare the car for the rivet gang.

Organization of repair gangs speeds up production

The rivet gang consists of four men who directly follow the fitter gang. The equipment for this gang consists of a portable rivet heater in charge of one man while the work of placing the heated rivet in the hole, driving and bucking up is performed by the other three men, respectively. The finishing-up gang, consisting also of four men, applies the couplers, draft gears and safety appliances. A gang of two men repairs the trucks while the body work is in process of completion. The air brake gang goes ahead of the dismantling gang and takes down the air brake equipment which is repaired and applied after the rivet gang has completed its work. The foreman in charge of the West Yard makes a final inspection and the shop clerk makes out work reports for each car.

Practically the same system is used in handling the repair work performed in the car repair shop building. The carpenters who perform the wood work on the superstructure of the box, stock and refrigerator cars move from car to car as their part of the work has been completed, and after one track has been finished, start down the next. Lumber is stored at the north end of the wood mill and is handled from storage by rail push car directly into the wood mill. As it is finished it can be taken directly to track No. 1 either by push car or gasoline tractor and trailer, and delivered direct to the car where it is to be used. The same system is also used when hopper or gondola cars are repaired in the shop building.

The system used for reclaiming car journal packing was described in the April, 1925, issue of the *Railway Mechanical Engineer,* page 219. The work of packing the

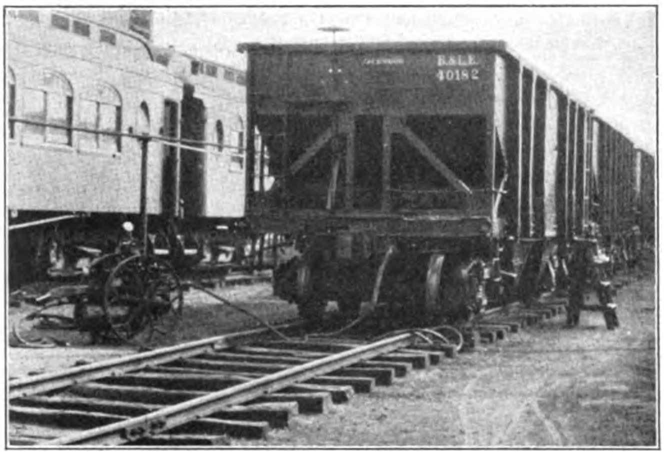


View taken from the south end of the car repair yard—The casting dock is shown in the right foreground, and directly in the rear is the gas cylinder storage shed—The coach shown in the upper center of the picture serves as an office for the store house representative

journal boxes is left until the cars are spotted on tracks Nos. 6 and 7. The journal box packing gang, consisting of three men, removes all the packing from the journal boxes and transports it in low-side steel wheelbarrows to a steel storage bin located just outside the oil and waste reclamation building. This building, referring to the drawing, is located midway between the wash house and acetylene cylinder storage shed.

Painting and testing

Sufficient tractors and trailers are provided for the general scrap foreman to remove all scrap from around each car as soon as it is thrown out. This facilitates the work of the car repair men and also enables the yard switching crew to pull the cars from each track as soon



The work of stencilling is performed during the final inspection and testing of the air brakes

as the steel work is completed. After the foreman completes the work of inspection and the work reports have been made out, the cars are switched to the East Yard where they are painted. The work of painting is performed by a gang of three men, two of whom operate mechanical painting equipments and the third man follows with a brush and wipes the paint down. Upon completion of the work of painting, the cars are weighed and placed upon tracks Nos. 6 and 7 where the brakes are tested and a final inspection is made. The cars are stencilled on the test tracks.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

The proper rider protection not provided in flat switching service

Under date of March 14, 1923, the Terminal Railroad Association of St. Louis, submitted to the Atlanta, Birmingham & Atlantic, an inspection certificate covering the condition of A. B. & A. flat car No. 5056. The inspection certificate bore the date of March 8, and showed the condition of the car to be as follows:

2—side sills split and broken,
2—draft sills split and broken,
2—intermediate sills split and broken,
1—end sill broken, new and old,
1—deadwood broken,
6—section struss rods bent and broken,
15—ft. of decking split, broken, worn and damaged.

The handling line considered that the car represented a case coming within the scope of A. R. A. Rule 120, as the estimated cost of repairs exceeded the limit allowed, except upon authority from the car owner. The car owner was requested to furnish disposition for the car. The car owner contended that the damage to the car represented unfair usage as the car was kicked without proper rider protection, and that it should be repaired at the expense of the handling line. The handling line contended that the car failed in ordinary switching service owing to its decayed and weakened condition. It further contended that it was neither the custom nor the requirement from the standpoint of safety to provide rider protection in flat yard switching service. The reason for this is that the cars are not switched at an excessive rate of speed and that the grade in the yard is not such as to cause cars to gain speed after being cut off.

In rendering its decision, the Arbitration Committee stated that, "The car was handled without required rider protection, as per Rule 32, Section D, Item 4; therefore, the handling line is responsible. See Decisions 1224 and 1331.

"With reference to the requirement for rider protection, the rule does not make any distinction between hump switching and flat yard switching."—*Case No. 1347, Atlanta, Birmingham & Atlantic vs. Terminal Railroad Association of St. Louis.*

Car protected by a rider before being damaged in switching service

Under date of December 26, 1923, the Terminal Railroad Association of St. Louis, submitted to the Atlanta, Birmingham & Atlantic, an inspection certificate for A. B. & A. flat car, No. 5160. The certificate indicated that the following repairs were required:

2—draft sills, split and broken,
2—intermediate sills, split and broken,
2—side sills, split and broken, new and old,
1—end sill, broken,
2—dead woods, split and broken, new and old decking, broken, worn, missing and damaged,
12—sections of truss rods, bent,
2—needle braces, broken,
3—sub-sills, broken.

The handling line reported to the car owner that the estimated cost of repairing the car at labor and material prices then in effect, amounted to $311.55, which exceeded the allowance under Rule 120 and, therefore, authority was requested to render a bill to the car owner or to dismantle the car. The car owner contended that the damage to the car resulted from improper handling as was indicated by the fact that the inspection of the car showed that it was entirely broken in two and that all sills showed new defects. The owner also contended that the car was in a previous accident as was confirmed by the statement of the car rider which was to the effect that timbers had already been broken in the car before it was broken in two. The car owner asked the handling line to furnish full information as to the previous accident but the handling line was unable to do so. Therefore, the car owner maintained that A. R. A. Rule No. 43 applies to this case, as there were more than five sills broken in the car. Furthermore, it contended that the car was improperly handled, as the cars which struck the damaged car were kicked without necessary rider protection, the rider having left the cars after riding them a short distance. The handling line stated that it complied fully with the requirements of Rule 43, as it furnished a state-

ment showing the manner in which more than five sills were broken, and presented the statement of the car rider which showed that the brakes had been set on the cut of nine cars which came in contact with the car damaged.

The Arbitration Committee rendered the following decision: "In accordance with the evidence presented, there was no mishandling on the part of the Terminal Railroad Association of St. Louis. The car owner is responsible." —*Case No.* 1348, *Atlanta, Birmingham & Atlantic vs. Terminal Railroad Association of St. Louis.*

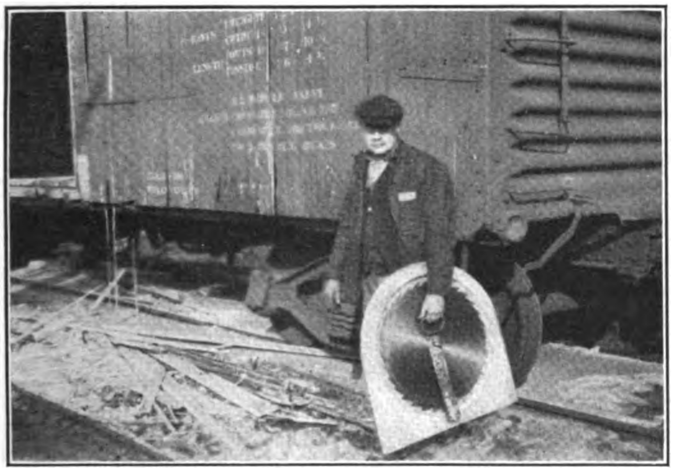
Statement must be furnished when wheels and axles are removed and replaced

On October 27, 1923, the Pere Marquette removed and replaced a pair of steel wheels on Bessemer & Lake Erie car No. 9251 on account of a cut journal. No wheel statement was furnished and when the car owner requested a statement the repairing line refused to furnish one on the ground that the rules do not contemplate the issuance of a wheel and axle report except when different wheels are applied from those removed. The car owner considered that this wheel statement was required for the reason that it is necessary for the owner to know whether the axles applied are within the limits of paragraph C, Rule 86. From the standpoint of the rules, the car owner claimed that it was required by Rule 9 that all the information shown in the second paragraph of that rule shall be furnished whenever the wheels and axles are removed and replaced. The handling line contended that as a "no bill" repair card covering the operation was issued, it was not necessary to list the data required in the second clause of Rule 9 and that this data should be furnished only when the wheels and axles are exchanged.

In rendering its decision the Arbitration Committee stated that "where the same wheels and axles are removed and replaced on account of a defect on either, a statement on the required form should be furnished regardless of responsibility for repairs."—*Case No.* 1349, *Bessemer & Lake Erie vs. Pere Marquette.*

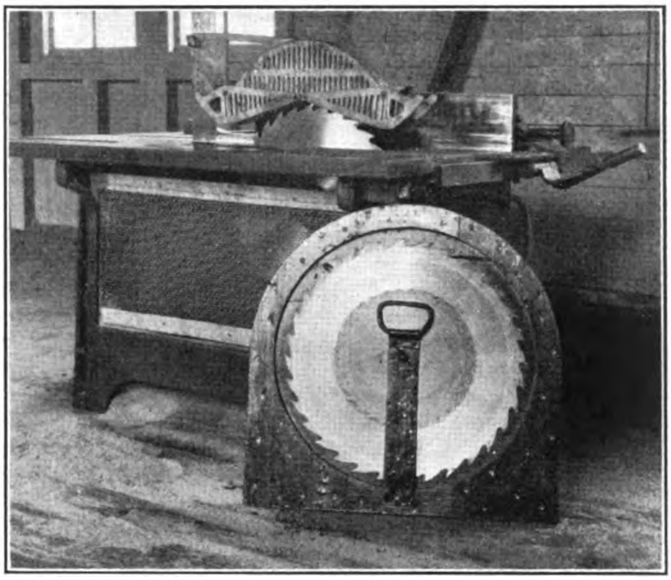
Protecting a rip saw and carrying saw blades

NO means were provided in guarding against the possibilities of a foreign object from coming in contact with the revolving saw blade in the rip saw shown in the accompanying illustration. Another rip saw is opposite the one shown. As a result of this arrangement, a workman handling a long piece of material, caused the end of it to come in contact with the revolving saw of the other machine with unpleasant results. The circular blades are now protected by a heavy piece of wire netting fastened to a substantial frame.



Seven rip saw blades can be carried with ease in this frame

Where this rip saw is located, no facilities are provided for sharpening the circular saws. As a result the saws must be sent to another shop for sharpening. As saw blades of this type are awkward to handle, the frame shown in the illustration was designed so that they could be easily carried. It is made of wood and contains a circular offset in which the blades fit. It will hold seven blades up to 24 in. in diameter. They are held in place by a 5/8-in. bolt and a wing nut which is screwed up tight against a 3/8-in. by 2-in. wide metal strap with a handle at the top end. The frame is painted black and has on the back, in yellow letters, the name of the two shops between which the saws are shipped.



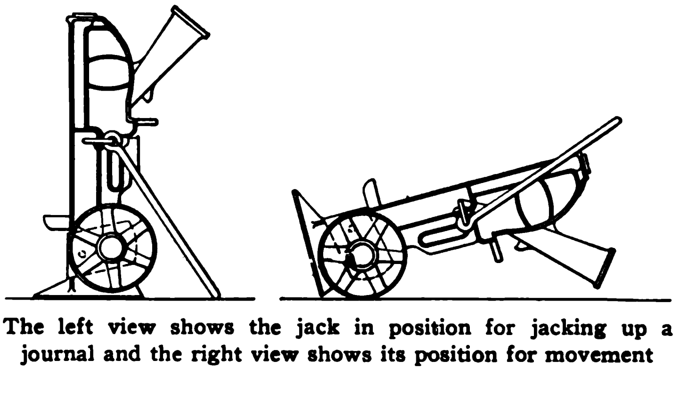
Wire guard for protecting revolving rip saw and frame for carry saw blades

Portable journal brass jack

By G. H. Fahrenbruch

General car foreman, C. B. & Q., Sheridan, Wyoming

THE accompanying illustration shows a portable journal brass jask which was made from a 15-ton ratchet foot jack by cutting out part of the jack at the base and applying a pair of wheels and a handle.



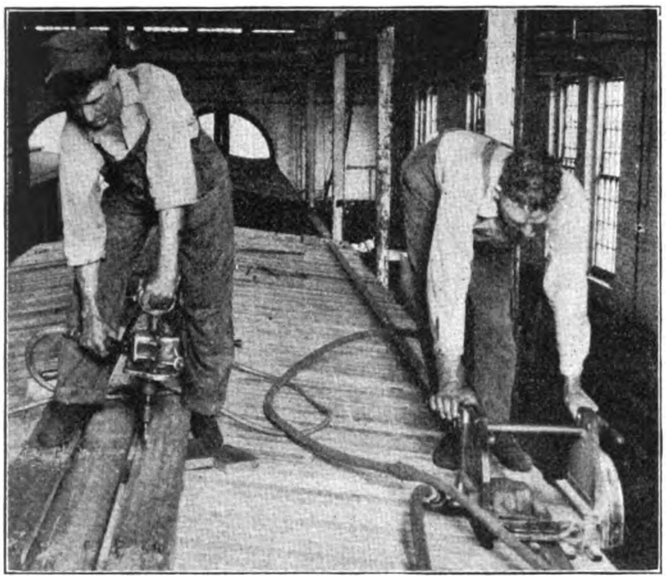
The left view shows the jack in position for jacking up a journal and the right view shows its position for movement

It is used for the jacking up of empty cars where it is necessary to remove the brasses for examination. Much time can be saved by the use of a jack of this type as one

side of the truck can be jacked up and both brasses changed in one operation. No blocking is required for setting up the jack. Furthermore, as the jack is on wheels additional time is saved as one repairman can move it from one job to another with little effort. This jack has been in service for over a year and has resulted in a substantial saving in time and labor on the repair track.

Air motor tools for use in car repair work

THE extent to which portable air motors can be used in car repair shops is indicated by the illustration. Two devices are shown, one of which is a motor driven screw driver and the other a circular saw for trimming the ends of roofing boards after being applied. With the aid of the motor driven screw driver, two men can apply running boards to a box car in 30 min. This includes the application of 18 saddle screws; 176, 3½-in. No. 16



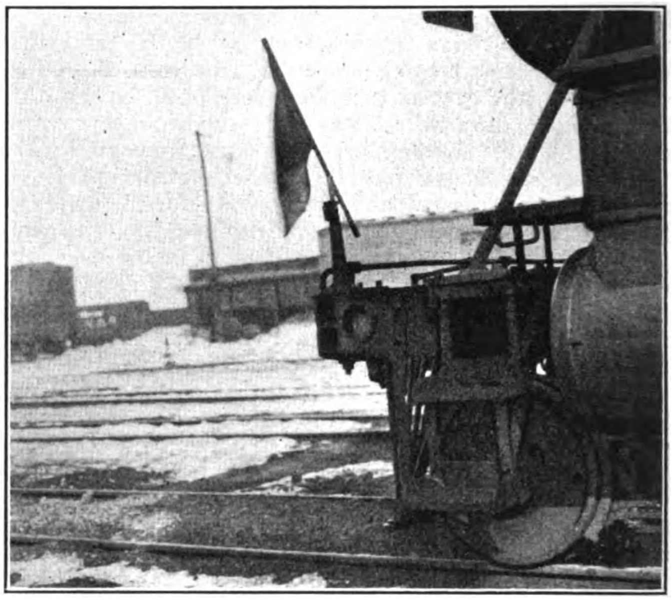
Motor driven screw driver and circular saw facilitate production in repair box cars

screws; two running board ties, and four running board braces. By removing the screw driver and inserting a socket wrench in the spindle shank, the air motor can also be used to tighten the nuts on the ½-in. bolts through the ties and end plates.

One man, with the motor driven circular saw, can trim the ends off the roof boards on both sides of the car in 12 min. This time includes the laying of the guide strip which serves to guide the saw as it is moved along the car.

Novel arrangement of flag to protect repairmen

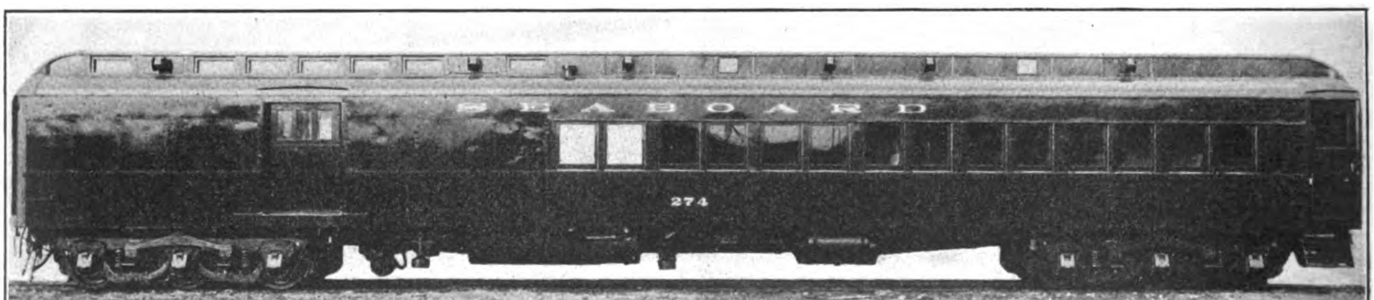
WHEN a yard engine comes in a repair yard to shift out cars or when a road engine is waiting to couple up with a train, the enginemen are often unable to see the flag protecting the repairmen. As a result many car repairmen have been either killed or injured. To eliminate this situation the flag shown in the



Flag projects over track at a 45 deg. angle, which permits a better view for the engineman

accompanying illustration has been fitted with an auxiliary stick made of sheet metal and curved so as to fit the circumference of the wood flag stick. The auxiliary handle is pivoted to the wood handle by a ⅛-in. pin. When the locomotive is waiting to couple up to the cars on which repairmen are working the metal handle is inserted into the flag bracket, so that the flag projects out at a 45 deg. angle with the flag bracket from the track where the engineman can see it.

This flag was designed at the Secaucus, N. J., car repair yard on the Delaware, Lackawanna & Western and is used at all of the repair yards and outbound train inspection points on this road.



Combination passenger and baggage car built for the Seaboard Air Line by the American Car and Foundry Company

Engine truck lubrication a serious problem

Present methods largely wasteful and ineffective—Causes analyzed—Remedies proposed

By W. H. Davis
General Sales Manager, Universal Packing & Service Company, Chicago

THE editor of the *Railway Mechanical Engineer*, in asking "What about engine truck lubrication?" has invited a discussion of what is admitted by most men in the lubricating field to be the most difficult point of lubrication on a railroad train.

Close contact for a number of years with railroad lubrication problems leads me to believe that less mileage is realized per hot engine truck journal box than for driving boxes, rod pins, trailer boxes, tank boxes or M. C. B. journal boxes on passenger cars. This condition, not peculiar to any individual railroad, is quite general. The freight car journal bearing is the only one in railroad service which affords less mileage per hot box than that realized with engine truck journals.

The difficult problems of engine truck lubrication are not new. They have been with us as long as the trucks themselves, but they have been particularly aggravating during the last year or two, coincident with the inauguration of longer locomotive runs. Hot engine truck journal boxes are more frequent on long runs, covering two or more divisions, than on the short division runs although there are, at times, too many of them on the short runs.

Truck frames covered with oil

The examination of almost any locomotive at the end of a long run will show that the engine truck frame, equalizer bars, springs, etc., is covered with oil—a veritable splash system apparently works quite efficiently on everything except the journals. This condition has always been prevalent. Long runs are not the cause; they merely make the condition more acute.

Only a comparatively small amount of waste and oil is used under an engine truck journal as compared with the amount under other journals of the same, or sometimes smaller, diameter. Yet the engine journal is subjected to the hardest service possible. A great many engine truck cellars are entirely too small and will not hold sufficient dope to produce good lubrication results. This is purely a question of design. The smallness of these cellars is probably due to the necessity of maintaining a stipulated under-clearance with a constantly increasing size of locomotive. The designer finds himself limited in the depth of the present style cellar on modern locomotives.

There is another objectionable feature of the shallow cellar. It is practically impossible to keep any kind of journal box packing in proper position in a shallow cellar. The dope becomes misplaced; rides up along the side of the journal; dries out under temperature, producing a waste wiper; or is in a position, when the brass jumps, to get between the brass and journal and cause a waste grab. Any one of these conditions eventually results in a hot box and, in many cases, in an engine failure.

On a new and properly designed locomotive there is a proper distribution of load on engine truck, driving and trailer journals. Between shoppings, the load can become quite unequally distributed by a weakening or improper alinement of the springs. A shifting of additional weight to the engine truck creates greater loads than intended and high temperatures result. A condition then exists which cannot be overcome by the medium of lubrication.

Engine truck bearings are subjected to a terrific hammering impact, due to crossovers and unevenness of roadbed, this condition being more prevalent immediately preceding a heavy cold snap or following it, when the roadbed has numerous "hard spots" due to uneven drainage. This condition tends to bring an increase in hot box troubles, especially cracked journal brass linings.

The foregoing are a few of the principal mechanical conditions peculiar to engine trucks that have to be faced

continually. How about maintenance and operating difficulties, so vitally affected by the human element?

From the very character of the construction, it is a far more difficult job to dope engine truck cellars properly than M. C. B. journal boxes and the majority of outside trailer boxes. When a locomotive momentarily stops at an intermediate terminal, it is comparatively easy to give the necessary service attention to rod pins, trailers and M. C. B. tank boxes, but, owing to the fact that the engine truck cellars are inside of the wheels in an inaccessible position it is practically impossible to give them any service attention under present conditions and practices, other than the application of a little top oil by the engineman.

We must recognize, when comparing long with short engine runs, that the physical characteristics of the situation are such that the roundhouse force cannot give any better attention to a long run engine truck than to one on an engine used in short run service. Therefore, from a lubricating viewpoint, the engine truck journals are expected to function for three or four times the distance on practically the same amount of terminal service attention. This is inconsistent, and the results show that engine truck journals do not function as well in the longer runs unless supplemented with service attention at intermediate terminal points. This intermediate service attention may seem poor practice and a waste of material and labor but it is vitally necessary on the long runs under present conditions and design.

Dope unduly dry following long runs

It has been found on a number of different railroads that the dope in the cellars lacks oil at the end of a long run, having the appearance of being well dried out. Evidently there is a substantial loss of oil from the dope while en route, through some definite cause. It is also a fact that far more hot engine trucks develop on the last part of a long engine run than on the first part of the run. The natural question is, "Where has the oil gone that was originally in the dope and by what medium did it pass from the dope, journal and bearing, to its new surroundings?"

A considerable part of the oil which should be in the cellar, on the journal, or between it and the brass, has distributed itself about the engine truck frame and on the right-of-way to such an extent that from 40 to 50 per cent of the original oil can be lost in one long engine run, necessitating a complete re-oiling or re-doping before the engine is started on its return trip. Why is this the case when trailer and tank boxes run continuously for a considerable period without any re-doping and with but occasional re-oiling?

Some are inclined to assume that the loss of oil in engine truck journal boxes is due to evaporation. This is an impossibility, for when the oil has reached a temperature to give off inflammable or combustible gases, it is on the danger line of the flash point, and, even though it stayed near that danger line throughout the trip, the entire loss of oil due to evaporation would not begin to account for the total oil loss. Therefore we must grant that evaporation is not the prime cause.

Lubricating engineers agree that the proper place to lubricate a journal bearing is from the bottom or sides. On an engine truck journal we locate an oil hole at the top, the most difficult point of lubrication and we have been trying for years to apply extra oil through that opening to take care of the rising temperatures which may develop en route when it is a point of egress rather than ingress.

What actually happens is this: the oil, by capillarity, leaves the dope in the cellar, distributes itself into a film between journal and brass, then collects in the oil slot in the lining of the brass at the top of the journal, is pumped from there through the oil hole in the brass, some of it going on up through the engine truck box oil hole, the majority of it passing between the brass and box, down the sides of the box, past the cellars, to be whipped by the wind over the engine truck frame and the right-of-way. Undoubtedly a small part finds its way past the ends of the cellar and box onto the axle and hub-plate.

The construction of the journal, oil groove and oil hole appears to form a very neatly working centrifugal pump. The majority of the oil collecting in the oil slot does not again find its way between brass and journal as this is the approximate point of greatest load and oil pressure. It would be most natural for it to follow the direction of least resistance, the exhaust port, so to speak, which is the oil hole leading to the atmosphere. That this action does take place, can be determined very easily and by simple methods.

I am quite convinced that about all the engineman has been doing on engine trucks with his oil can at intermediate stations is to prime the pump for further action when his locomotive is again under way, much to the detriment of the condition of the dope in the engine truck cellars.

When a locomotive is in transit, there is a constant pressure of oil struggling for freedom and it is greatest near the top of the journal. This pressure is determined by the load and speed and also increases in direct ratio with the increase in speed of the locomotive. This oil pressure is greatly diminished when the locomotive is at rest and when it hits a hard spot in the road bed or a cross-over when traveling at a fair speed, at which time the brass leaves the journal and momentarily relieves the pressure.

The idea of the oil being pumped up through the oil hole by centrifugal pump action, or whatever else we may choose to call it, may be new but there is plenty of precedent to sustain the conclusion that we are now thinking along correct lines. Take a few specific instances for illustration. That of the engine driver grease cellar is a good one. During its first application there was an oil hole in the top of the driving box. The grease came through this oil hole like shaving cream from a tube. An effort was made to overcome this by plugging the oil holes with tapered plugs. The grease pressure was sufficient to force out the plugs. The oil holes were eliminated and desirable lubrication was achieved.

Added oil gave temporary relief

I recall one railroad that began to have an abnormal number of hot engine truck boxes when the long engine runs were started. Those in charge realized that the oil was leaving the cellars and they made some long squirt oil guns with which the men could reach across the engine truck frame. At intermediate engine terminal points the mechanic would place the nozzle of the gun in the neck of the journal cellar and insert additional oil on the dope. Engine truck hot box troubles soon became a thing of the past on this road. I do not intend to imply by this illustration that the foregoing was desirable practice or the best way to effect a cure, but it does show that the adding of oil stopped the trouble, which is a strong indication that it was the lack of oil which caused the trouble.

On another railroad, where they had considerable engine truck trouble on long runs with certain high speed locomotives, they were having no trouble with locomotives of exactly the same type, running one-half the distance and over the same line of road. The cellars of the former showed a lack of oil at the end of the long run while the cellars of the latter had sufficient oil, not running far enough for the loss of oil to become vital.

Basing my deduction entirely on personal observations of extensive experiments carried on by railroad men, with all credit to them for the progress made, I find myself thoroughly convinced of the following facts:

There is, and always has been, a substantial loss of oil from engine truck journals while in transit. The loss is making the cost of engine truck lubrication greater than it should be and it is detrimental to cool running of the journals. The occasional top oiling by the engineman appears to be a rather useless and wasteful procedure. The major loss of the oil is through the oil hole in the brass.

Suggested alterations in practice

The oil hole should be eliminated, but a method of applying oil to the dope should be incorporated so that a quick rising temperature, en route, due to some mechanical defect, can be overcome by adding the necessary oil. The application of additional oil should only be made when necessary on account of high temperature. Everything being normal, the engine truck should run from main terminal to main terminal without any additional oil. Eliminating the oil hole in the brass is suggested as a method of securing improvement on present equipment without any expensive or radical change in design. One important railroad has already developed changes along this line.

To offset the difficulties permanently, it appears desirable to redesign the engine truck box and cellar. A practical method would be to have a ledge on the inside wall of the engine truck box (cast steel, only) and have the cellar slide into position with its side walls behind the ledge, so that the oil running down the inner sides of the box would return to the cellar instead of going down past the cellar walls, as at present. Also, a real improvement can be realized if the cellars are designed with more depth than many of those now in service.

It is absolutely essential, in order to secure desirable engine truck journal lubrication, that the engine truck cellars be taken down and the dope put in proper condition before the cellars are again returned to place. This should be done every trip on all passenger and high-speed freight locomotives. If done on all locomotives it would probably be money well expended. When the cellars are down, a very careful examination of the journals, brasses and co-related parts, by a competent employee, will bring results and reduce the number of high temperature journals.

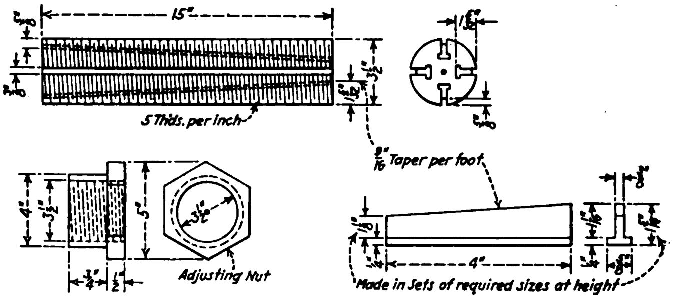
Hot boxes are like the proverbial taxes. They have always been with us, are with us and probably always will be, but we hope in constantly decreasing numbers. The majority of the railroads are constantly striving for better lubrication and the splendid results obtained are indicative of the success of their efforts.

A number of the principal railroad systems of the country are now getting more than 250,000 locomotive miles per hot box, more than 1,000,000 passenger car miles per hot box and more than 100,000 freight car miles per hot box. A comparison of these results with those of a few years ago, shows that tremendous progress has been made. In conclusion, I venture the prediction that each succeeding year will show a continued improvement.

POLISH ENGINEERS have calculated that it costs 186,000 zloty ($35,898) to manufacture a standard locomotive in Poland compared with 220,000 ($42,460) in England, according to Assistant Trade Commissioner Ronald H. Allen, Warsaw. In Germany, locally manufactured locomotives are produced at figures about equaling costs of manufacture in Poland, but the export price on the German product, owing to the dumping system, is less than the Polish manufacturers can sell for.

Adjustable rod brass and bushing arbor

An adjustable arbor used for turning the outside of rod brasses and bushings is shown in the drawing. Four taper slides fit into tee-shaped grooves machined in the arbor spindle. Taper slides of various heights can be used as required for different diameters of bushings or



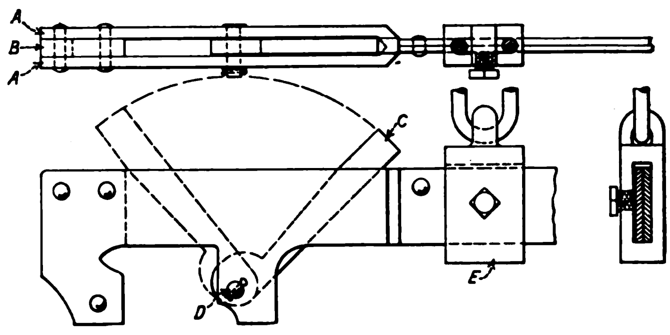
Drawing showing the detail parts of an adjustable arbor for turning bushings or rod brasses

brasses. The spindle, with the taper slides in place, is inserted through the center of the bushing or rod brass and the slides are set up and held to the work by the adjusting nut which is threaded to screw on the spindle. The use of this adjustable arbor enables the operator to turn rod brasses and bushings with little adjustment after it has been once placed in the lathe.

Clamp for holding tires on a boring mill

By F. M. A'Hearn

The clamp shown in the drawing will be found convenient for holding driving wheel tires when placed on the table of a boring mill or when stored in piles, one on top of the other. The side pieces *A, A* are separated at one end by a filler block *B* so as to form a housing for the cam *C*. The side pieces of the section occupied by the cam *C* are drawn together as shown in the drawing,



Drawing of clamp for holding driving wheel tires on the table of a boring mill

to form a handle. The cam is pivoted on the pin *D* which moves in the arc shown, gripping the tire, which is laid flange side up. The block *E* is adjusted to bring it to the center of the tire and is secured by a set screw. When properly adjusted the tire will balance in a horizontal position which provides safety as well as speed in handling.

Kinks for the blacksmith shop

Descriptions of some of the shop devices brought out at the last Blacksmith's convention

MANY of those attending the last annual convention of the International Railroad Master Blacksmiths' Association, which was held at the Hotel Winton, Cleveland, Ohio, August 18 to 20, 1925, brought sketches of blacksmith shop kinks and fixtures with them. These sketches were posted on the walls of the convention hall and attracted considerable attention. The *Railway Mechanical Engineer* is indebted to a number of the members of the Master Blacksmiths' Association for their co-operation in obtaining complete information relative to the fixtures described in this article and also to the secretary, Wm. J. Mayer, for the drawings, photographs and sketches.

Tool for welding spring bands

Fig. 1 shows a tool for welding spring bands under a steam hammer. The base of this tool is a forging 5 in. thick and about 18 in. long by 20 in. wide. It contains a recess about 2 in. deep so as to admit four 3-in. blocks as shown in the illustration. These blocks form a pocket in which the band is placed while being welded. The band comes to the hammer bent to the shape shown at

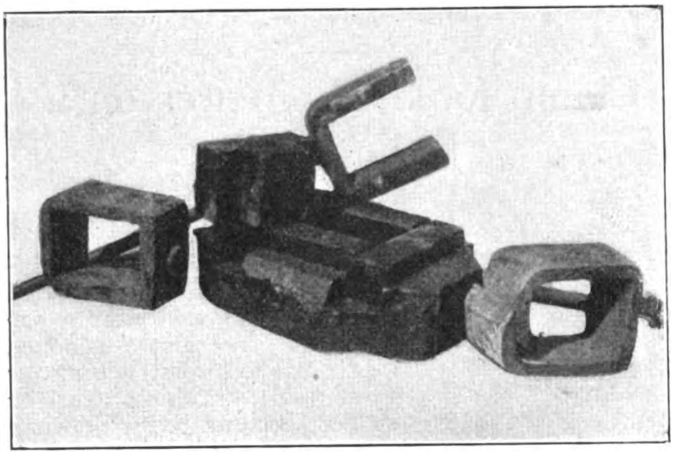


Fig. 1—Tool for welding spring bands under a steam hammer

the right of the illustration. The tee-shaped block, shown resting on the base, is placed inside the band which has been placed in the recess of the base with the part to be welded at the top. The projection of the inside block extends down about 2 in. into the recess with the horizontal arms of the tee resting on the two side blocks. The legs of the U-shaped piece, which is provided with a handle and is held by the operator, fit on the outside of the band and rest on the inside block. This prevents the sides of the band from spreading while being welded. Spring bands can be welded with this fixture, forming a boss with a tool held under the hammer; at the same time if desired, as fast as they can be heated.

Forging spring hangers for passenger cars

The dies and formers shown in Fig. 2 are designed for making spring hangers on a 4-in. Ajax forging machine. The hanger comes to the forging machine as shown at the top of the sketch. The jaws of each are heated and shaped with the headers shown at the left of the sketch. A feature in the construction of the header used for this job is the groove at the end which leaves a bead at the base of the jaws where the two parts of the hanger are welded together. This tends to give additional strength to the weld by filling up the recess which is usually left between the two halves at this point. A

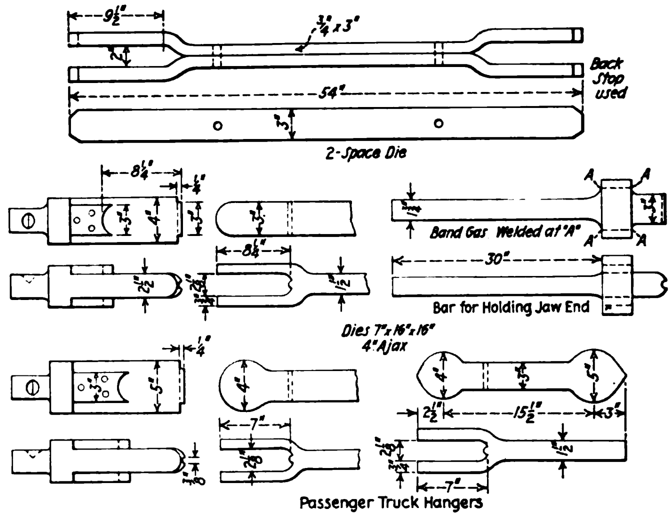


Fig. 2—Sketch showing dies and formers for making spring hangers for passenger cars

bar for holding one end of the hanger while the other end is being forged is also shown in the sketch. This bar has a ring welded to the end which fits over the outside of the jaws while the end is shaped to fit snugly inside the jaws.

Manufacturing spring hangers and reclaiming brake hangers

The dies and formers shown in Fig. 3 are being used successfully in the blacksmith shon of a large western railroad for manufacturing spring hangers and reclaiming brake hangers. The spring hanger is brought to the forging machine as shown at the top of the sketch. The header for forming the ends has a groove which forms a bead at the division between the patch and the body part of the hanger. The filet can be formed to suit the thickness of the patch by setting the back stop and shoving the hanger ahead in the die.

Brake hangers usually come to the blacksmith shop with the holes worn out of round. These can be reclaimed by heating, placing a plug of the proper diameter in the hole as shown in the sketch at the lower left of the figure, and forming the ends by means of the header shown at the lower right. This job is performed on a $2\frac{1}{2}$-in. bolt header. The die shown at the bottom of the figure is used for shaping the remaining curved portion of the ends.

Punch for irregular cutting and die for making battery box hinges

Frequently the blacksmith shop is asked to perform jobs requiring the cutting of holes or notches of irregular

shape. The punch shown at the top of Fig. 4 has been designed for this sort of work. It is used on a 2½-in. double punch and shear. The leg of the punch moves

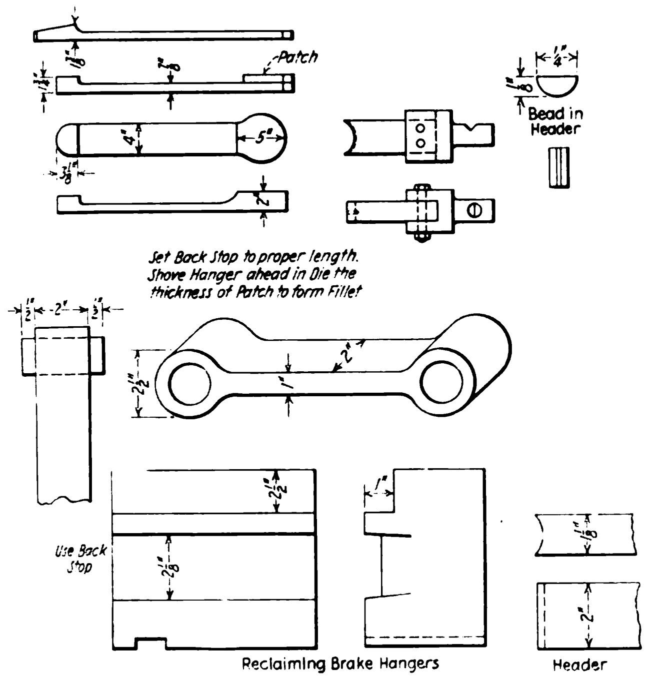


Fig. 3—Dies and formers for manufacturing spring hangers and reclaiming brake hangers on a forging machine

up and down in the die shown in the upper right hand corner of the sketch, only the cutting portion of the punch

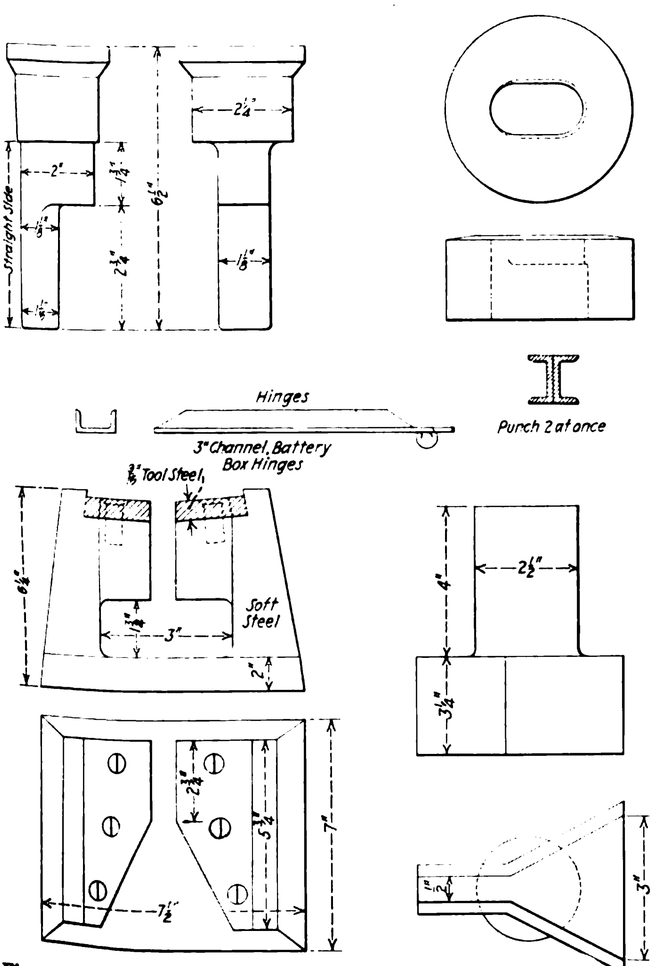


Fig. 4—Sketch showing a punch for irregular cutting and die for making battery box hinges

clearing the top of the die sufficiently for the work to be pushed against the leg of the punch.

The die shown at the bottom of Fig. 4 is designed for cutting battery box hinges from 3-in. channels. The hinges are formed in the die, the female portion of which is shown at the lower left and the male portion at the lower right of the sketch. The die trims the flanges of two channels at a time, as shown in the sketch of the hinge, and the loop for the hinge pin is formed in another operation.

Manufacturing small locomotive parts on the forging machine

The set of dies shown in Fig. 5 is used in the blacksmith shop of an eastern railroad. Die No. 1 is used for forging grease cup caps on a 3-in. forging machine, die No. 2 is used for making cylinder cock valve stems on a 2-in. forging machine and die No. 3 is used for making enginemen's hammers out of 1½-in. round steel, also on a 2-in. forging machine. Dies Nos. 4 and 5 are used for forging ash pan shaker levers and cradle pins, respectively, on a 3-in. forging machine. Steam chest relief valves and trailing truck adjusting rods are forged in

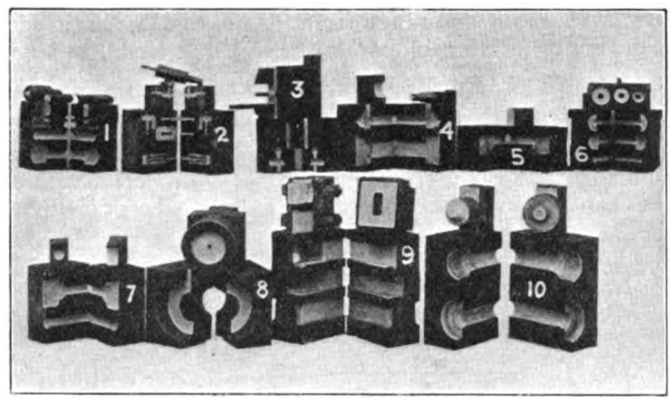


Fig. 5—Set of dies for forging miscellaneous locomotive parts

dies Nos. 6 and 7, respectively, on a 3-in. forging machine. Die No. 8 is used for forging collars on car axles on a 5-in. forging machine. It is made in different sizes to suit each A. R. A. size of journal. Spring plank hangers for steel passenger cars having Commonwealth trucks are forged in die No. 9, and die No. 10 is used for making ash pan and smoke box diaphragm studs. Both of these dies are used on a 5-in. forging machine. The studs are cut from bar stock and the slot is punched in the same heat. The die shown setting on top of die No. 10 is used for forging crank pin washers on a 5-in. forging machine.

Making steel bushings for side and main rods

The dies shown in Fig. 6 are used for making steel bushings for side and main rods on locomotives having floating bushings. This fixture is designed to be used on a 5,000-lb. steam hammer. The blanks from which the bushings are made are 6 in. thick by 11¾ in. in diameter and are cut from scrap axles. The blank is placed on top of the block *C* under the die guide No. 1, shown in the sketch. The plug *A* is then placed in position, as shown, and is driven down to form the bushing. The driving down of the plug *A* forces the metal up between the sides of the plug *A* and the die. After this operation the plug *A* is removed from the top and the die is moved back to let the plug *C* drop out. The sleeve *D* is then placed in the bottom of the hammer die, guide No. 2 is placed on the top of the bushing and the punch *B* is driven through the center of the bushing. Upon the completion of this operation the die is turned over and the various

parts are allowed to drop out. Both of these operations are performed in one heat. The third operation consists of heating the bushings and expanding them to suit the

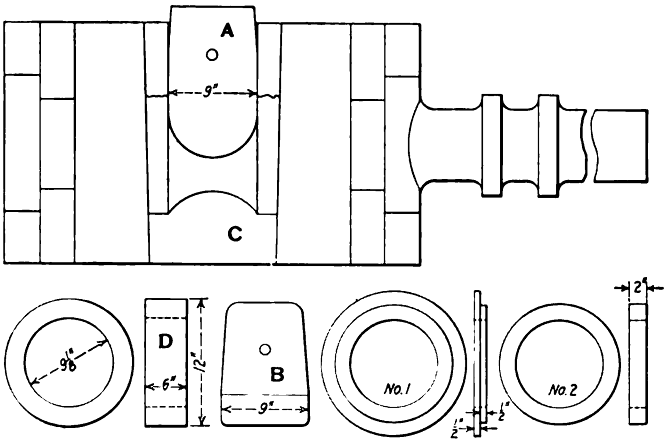


Fig. 6—Sketch showing dies for making side and main rod bushings

various classes which range from 9½ in. to 11½ in. inside diameter, by driving mandrels through the bushings.

Forging clinker hooks

Fig. 7 shows a sketch of a die for forging clinker hooks on a 4-in. forging machine. The jaw end of the handle bar is upset and punched on a 2½-in. bolt machine. The handles may be formed on a bulldozer or with a

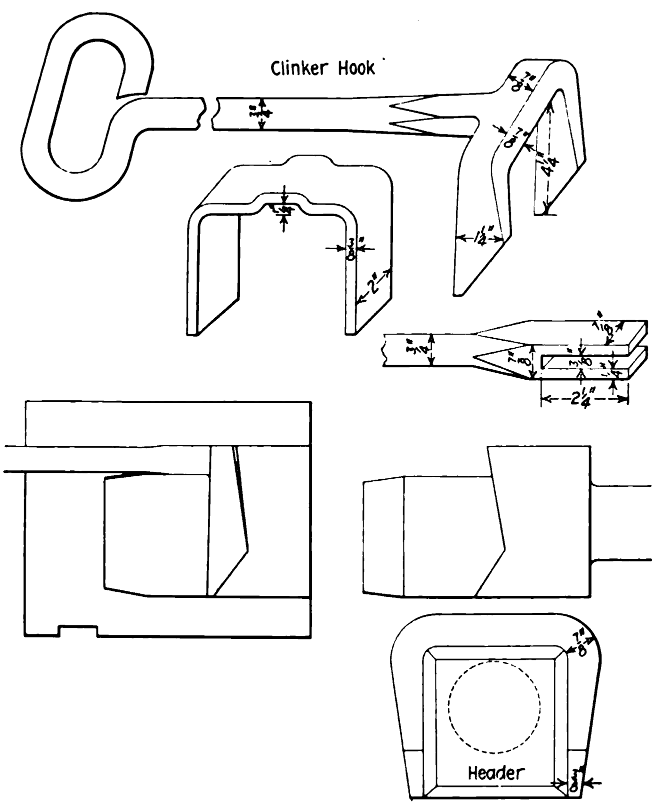


Fig. 7—A die for forming clinker hooks on a four-inch forging machine

jig on a bolt or forging machine. The hook is bent from a 2-in. by ⅜-in. flat iron on a bulldozer and the handle bar jaw is welded to the top of the hook. The hook is formed in the die, as shown in the sketch, with one stroke of the 4-in. forging machine.

A handy set of dies, swedges and stamping tools

Shown in Fig. 8 is a miscellaneous assortment of dies, swedges and stamping tools that are being used by the blacksmith department of an eastern railroad. Referring to the illustration, the joint group of tools shown on the left in the top row is a set of swedging and stamping tools for making cylinder push rods; the second group is a set of formers for bending pilot frames; the third group is a set of dies for forging switch feet on a 3-in. forging machine; the fourth group is a die, the female part of

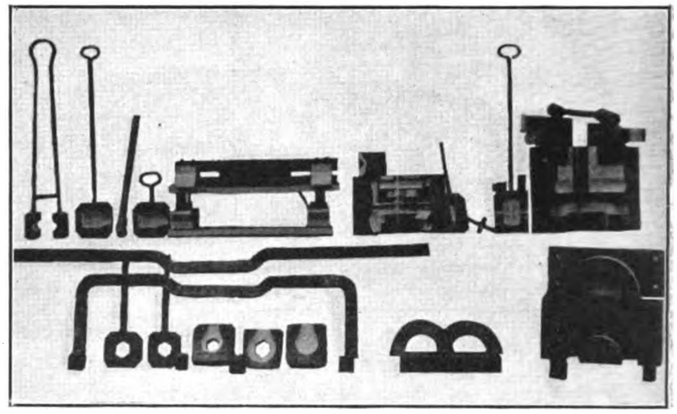


Fig. 8—A set of swedges, dies and stamping tools

which is shown leaning against the switch feet dies, or making ½-in., ¾-in., ⅞-in., 1-in., and 1¼-in. spring hanger gib seats. This die is designed for use on a power hammer. The last group of the top row is a set of dies for forging link lifters.

In the bottom row of the illustration, the first group is a set of tools for forming knuckle and wrist pin wrenches and the last group, shown at the right, is a die for punching out hub liners from boiler plates on a bulldozer.

Making coupler yokes

The sketch shown in Fig. 9 is a fixture for making coupler yokes on a bulldozer having a capacity for a 19-in. stroke. The jaws *B*, bolted to the face plate *A*, have

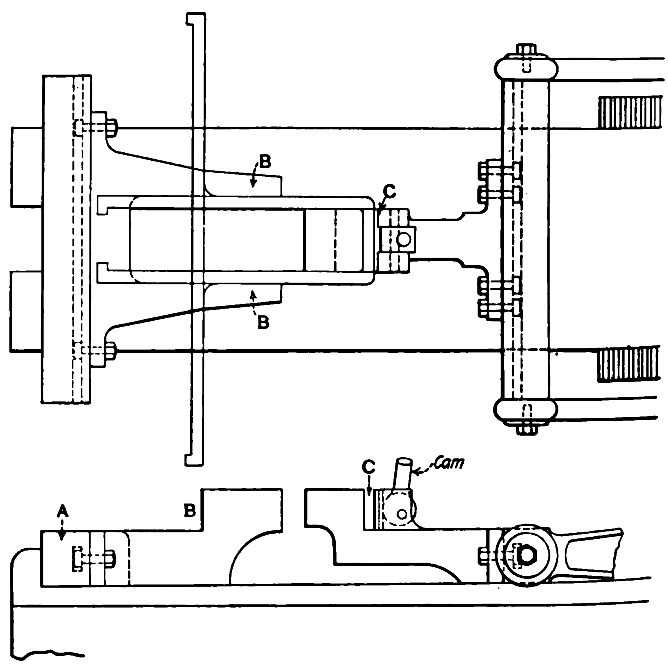


Fig. 9—Fixture for making coupler yoke pockets on a bulldozer

lugs on the ends, the inside corners of which are curved as shown. The ram is moved forward between the jaws and the piece from which the coupler yoke is bent is placed in the vise C of the header. After the piece is centered it is clamped in place by the cam which is pivoted in the rear of the header fixture. The coupler yoke is formed on the return stroke of the bulldozer, the ends being bent parallel to each other by the curved lugs on the jaws of the face plate fixture. The piece is heated at the center only.

Former for bending sway chain hooks

The former shown in Fig. 11 is designed for bending sway chain hooks. The female dies are made of axle steel and the male die of wrought or open hearth steel. An assembly drawing of the former is shown in the upper left corner of the figure. The eye of the hook and the point is made in the usual manner. The former is used for bending the hook to its final shape. This insures hooks of standard dimensions and speeds up production by eliminating the time required in calipering the hook for proper dimensions.

Formers for bending suspension brackets for car lighting generators

The formers shown in Fig. 10 are designed for bending center suspension brackets used for suspending car lighting generators under passenger cars. The brackets are made of spring steel. Referring to the drawing, the first operation consists of punching the holes and cutting the slot on an 18-in. double punch and shear. The second operation consists of bending the loop for the hinge pin.

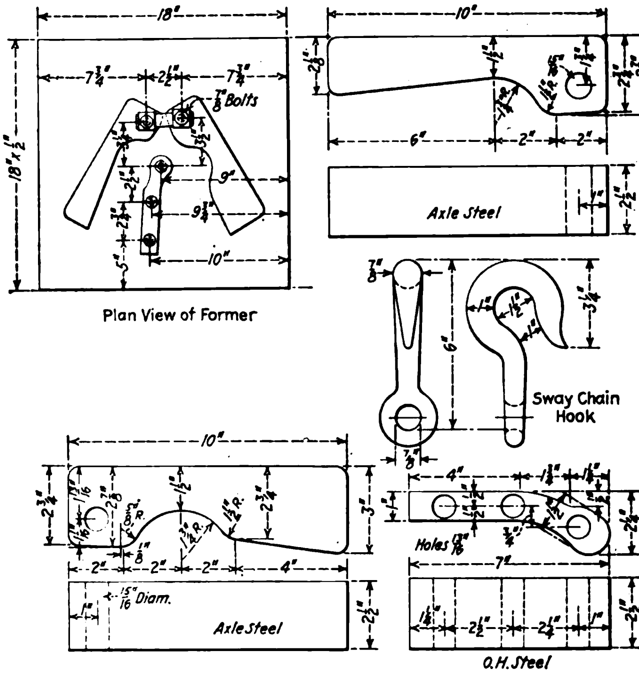


Fig. 11—Former for bending sway chain hooks

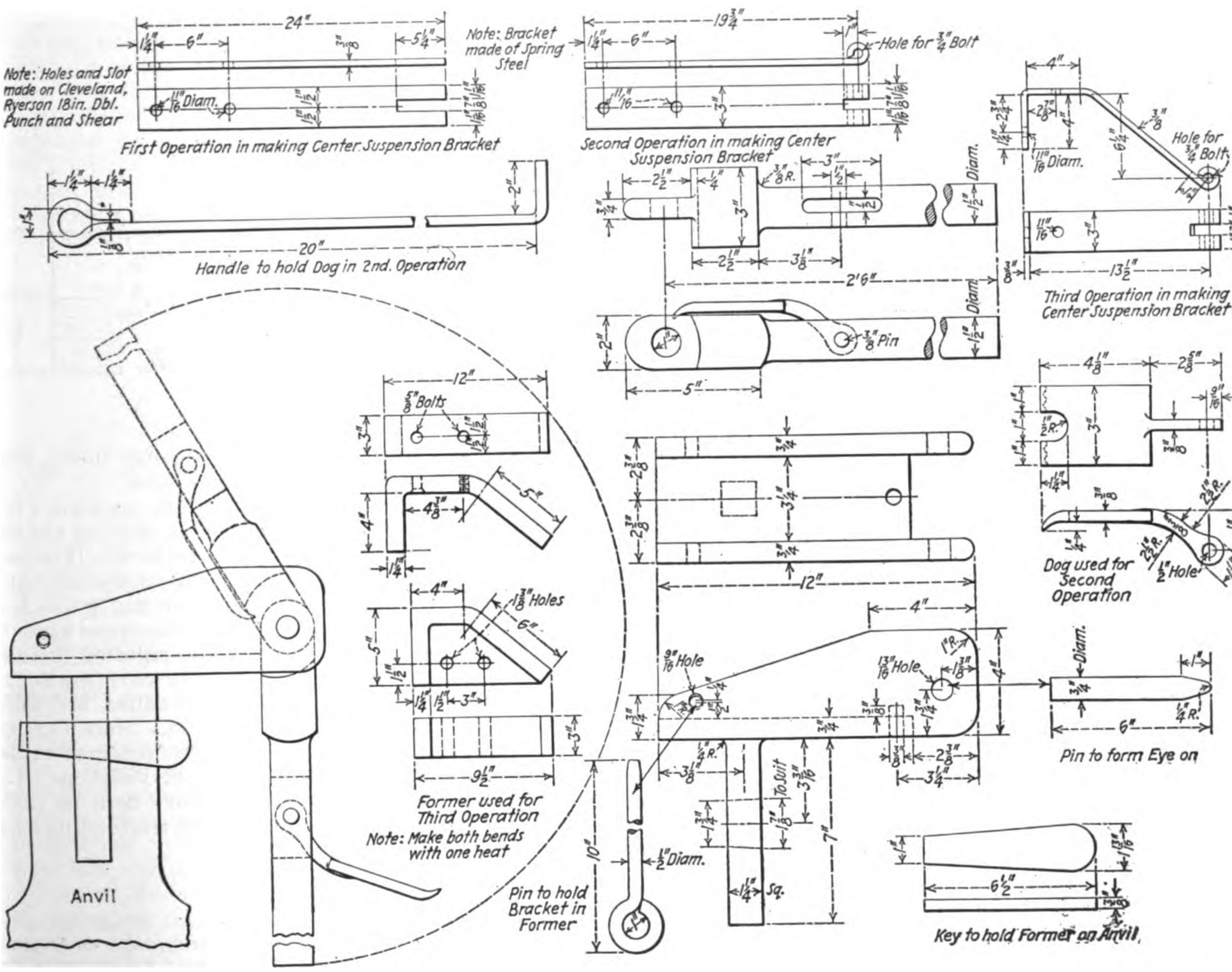


Fig. 10—Drawing showing a set of formers for bending center suspension brackets for car lighting generators

The former shown in the lower right center of the drawing is placed on the anvil, as shown in the assembly drawing at the lower left, and is held in place with a key. The bracket is placed in the former and the ends from which the hinge pin loops are formed are bent back by placing the end of the dog over the ends of the bracket which form the hinge pin loop and the ends are bent over as the handle is moved up, as shown by the dotted line. The third operation consists of bending the bracket to its final shape, as shown in the upper right hand corner of the drawing, in the die shown in the drawing. Both bends are made with one heat.

Former for bending S-hooks

Fig. 12 is a drawing of a former for bending S-hooks from 5/16-in. bar iron. The former consists essentially of two parts; a stationary base, and a part which revolves on the base. The latter is fitted with two handles so that it can be rotated by the blacksmith. The two outer pins rotate as the handles are turned while the two center pins, screwed in the base, remain stationary. The outer pins can be adjusted by loosening the ⅝-in. bolts and moving the slotted pieces, in which they are set, as desired. The hook is formed by placing a straight piece of 5/16-in. bar iron of the proper length between the two outer pins. As the handles are turned the outer pins twist the bar around the center pins until the hook is formed.

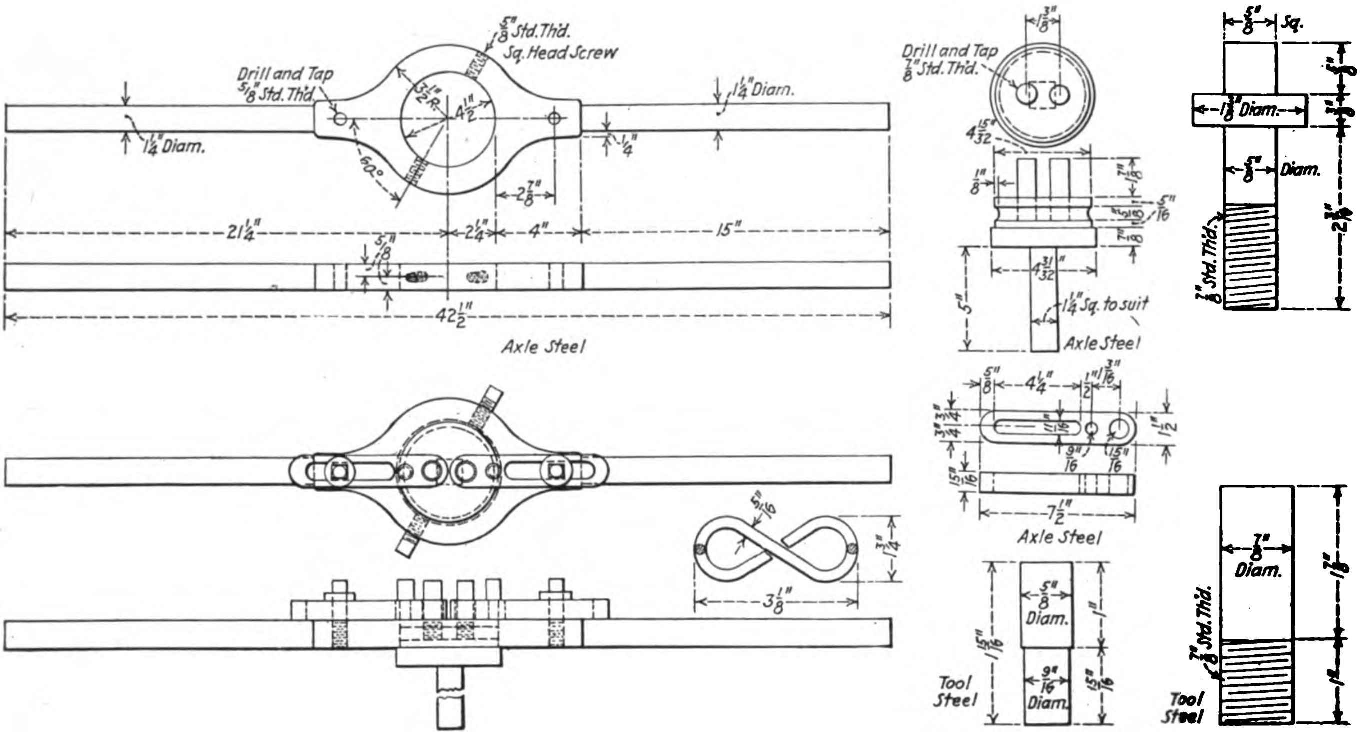


Fig. 12—Former for bending S hooks

Use of safety cards reduces accidents

A CARD system has been devised by Robert W. Wray, master mechanic of the Williamsport Division of the Pennsylvania, Renovo, Pa., which puts the "safety first" proposition strictly up to each individual workman. Remarkable results have been achieved by the use of this system in the Renovo shops as is shown by the fact that an 85.7 per cent reduction in accidents for the last 26 days of October has been brought about, as compared with the same period in October, one year ago. Last year's report showed that 42 accidents had occurred at Renovo and but six during the same period for this year.

The system is such that each workman is held personally responsible for his adherence to the safety regulations. Each man is provided with a card of a size to permit of its being carried in the vest pocket. On one side, spaces are provided for the date, the employee's name, occupation, and the name of the person observing the violation of the rules. On the reverse side is the name and address of the master mechanic. A certain number of these cards are given to the foreman, gang foreman and safety committeeman. If an employee is actually violating a safety rule, such as working at an emery wheel and not wearing goggles, chipping without goggles, cutting steam hose without shutting off the steam, etc., a card is filled out and given to him to sign. The card is also signed by the employee observing the violation of the safety rules. This card is then turned into the office to be filed.

Should three cards be turned in against one man, a red card similar in form to the white card, is attached and the four cards are given to the master mechanic. The employee is then called to the office or the master mechanic goes into the shop, talks to the employee and warns him that on receipt of another card on which his name appears, disciplinary action will be taken. It is reported that the men in the shops are beginning to have considerable respect for the safety rules, since their names are liable to appear in connection with a violation. Since October 1, 1925, a total of 111 cards have been returned to the office, all of which are concrete cases of violations. Up to the present time, however, there have been no cards turned in showing the same man's name a second time for violation of safety rules.

The Interstate Commerce Commission has denied the petition of the New York, New Haven & Hartford for modification of its second train control order, except insofar as to make the effective date July 18, 1926, instead of February 1.

Methods of increasing output in small machine shops

Sketches and work orders important factors in the economical production of small parts

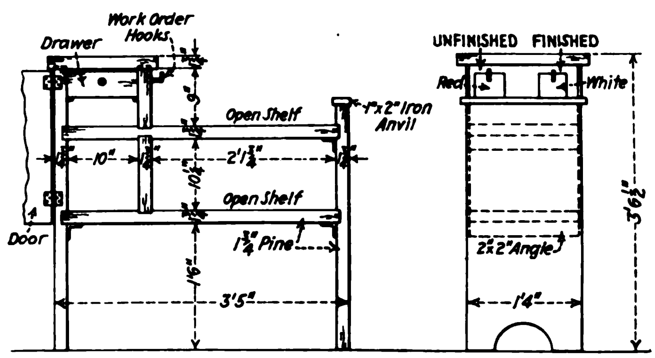
By R. B. Robinson
Atlantic Coast Line, High Springs, Fla.

A MACHINE shop large enough to require the service of a supervisor is not too small for the application of systematic methods. With this thought in mind systematic methods have been applied in these shops, which have assisted greatly in putting the work on an economical basis. In order to obtain such results in a small shop it is essential to arrange the shop fixtures for the convenience of the movement of materials and to facilitate the work of cleaning up; to prepare complete data sheets and charts, arranged in condensed form for quick reference, and to put into use a combined work order and sketch form for distribution of work including running repairs and stock work. After having done this, the supervisor will be relieved of a great deal of work that would otherwise result from the presence of useless material and confusion. He can then apply himself to refining his system of operation.

It is not uncommon practice in small shops for each machinist to secure, in some way, from time to time, a bench or box for his tools and work, selected according to his own belief as to his requirements. The result is a heterogeneous array of stands, lockers, nooks and corners, catch-alls for scrap and for material that can not be found when most needed, causing confusion and loss of time.

To make the necessary correction it becomes important, therefore, to formulate some definite plan of arrangement

While this performance might appear to be rather an exacting requirement for a small shop, it means the elimination of the usual ceremony in the morning of distributing the day's work, the preliminary distribution



Machine operator's bench and locker

having already been arranged on the "unfinished work" file by the time and work signal has sounded.

To further increase production and eliminate the possibilities of errors, sketches or drawings were made of the small locomotive parts turned out in this shop. Some of

Eng. Number	Eng. Class	Steam-Sup. Ht. or Sat.	Cylinder Size-Nominal	Patt. Nos. of Side Rod Brasses: Front	Back	Int'm.	Main	Knuckle	Eccentric R.	Patt. Nos. of Main Rod Brasses: Front	Back	Size of Met. Packing: Piston Rod	Valve Stem	Driving Boxes-Patt. No.: Main	Others	Crown Brasses-Patt. No.: Main	Others	Driving Box Cellars-Patt. No.: Main	Others	Driving Box Shoes-Patt. No.: Main	Front	Back	Driving Box Wedge-Patt. No.: Main	Front	Back	Eng. Truck Box-Patt. No.	Eng. Truck Brass-Patt. No.	Eng. Truck Cellar-Patt. No.	Trailer Truck Cellar-Patt. No.	Trailer Truck Box-Patt. No.	Trailer Truck Brass-Patt. No.	Remarks
721	L	S.H	22x30	J43	J43	I43	B52	G-43	K43	L-53	A140	3¾	2	K-33	J-33	I-38	G-38	S31	Z-31	S72	H-72	K-72	S-71	H-71	O-71	J-50	P39	O-32	R-23	R-25	W-39	
722	L-1	S.H	22x30	J-43	J43	I-43	B52	A-43	K43	P53	B140	3½	2	K33	J-33	M-38	H-38	P-31	S-31	P-72	I-72	K-72	P-71	H-71	S-71	K-50	P-39	N-32	L-23	S-25	W-39	
723	L-2	S.H	22x30	J43	J43	F43	P52	L-43	K43	L-53	V-140	3¾	1¾	K-33	S-33	N-38	G-38	S-31	Z-31	S-72	H-72	K-72	S-71	H-71	O-71	N-50	P39	O-32	R-23	R-25	W39	
724	L	S.H	22x30	J43	J43	B-43	B52	G-43	K-43	L-53	A-140	3½	2	K-33	S-33	I-38	G-38	S31	Z-31	S-72	H-72	K-72	P-71	H-71	S-71	K-50	P39	N-32	L-23	S-25	W-3	

Machinist's data sheet which contains important dimensions and pattern numbers of castings most frequently renewed

of the shop equipment as well as a system of work distribution. This suggests a uniform design of cabinets for the machinists, provided with places for work and lockers for tools. Such a machinist cabinet is shown in one of the illustrations. On the end of the cabinet are two places for files, one on a red field and the other on a white field. The red file is for orders of work to be done, arranged in the sequence required and marked "Unfinished work." The white file is used for order forms when the work is completed and is marked "Completed work."

these sketches are shown in the accompanying illustrations. The introduction of sketches was confusing for a while on account of the inability of the machinists to read them, but after some instruction, the sketches were understood. As a result, in a short time, we had a gang of machinists who are able to read sketches and blue prints, and who are thoroughly trained to this system of work distribution, performing their work in a straightforward manner without confusion.

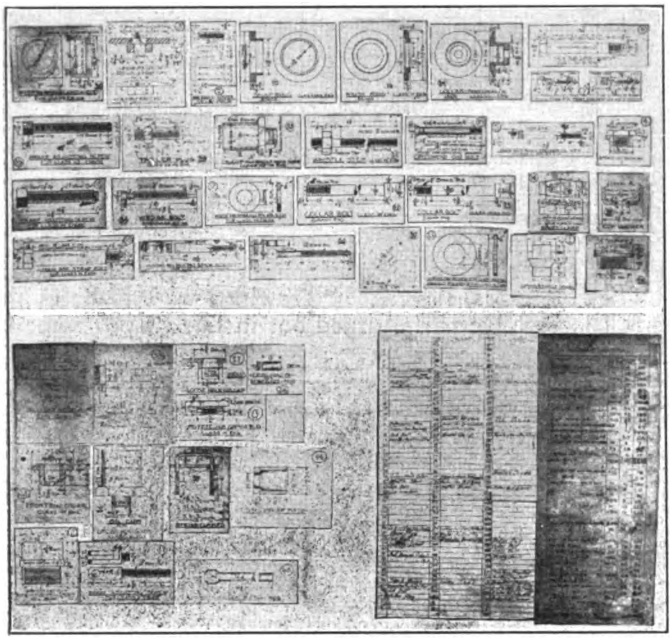
It was surprising to learn of the number of good me-

chanics who were unable to read drawings. Therefore, as a result of the experience gained in the training of the machinists to carry out written orders with sketches, the writer is now arranging for a short course of instruction in pencil drawing and sketching of parts for those under his supervision.

In order that every one may become familiar with the work turned out at this shop there is kept under glass duplicates of standard drawings of repair parts most commonly made in the machine shop. Also, there are pencil sketches covering pieces used locally as standard but which have not been sketched and tabulated on standard drawings.

These drawings and sketches are made sufficiently small to be convenient for easy reference. They each bear a sketch and bin number so that in making up stock, the machinist is simply referred to the sketch by number for dimensions. The repairmen, too, have fallen into the habit of making use of the frame of detailed drawings in locating bins containing parts wanted. Helpers and others not conversant with the names of these parts, also find these drawings an aid in locating material bins.

The stock in the bins is machined largely by the apprentices. In fact, they are generally required to keep these bins in order and to replenish them when the stock is depleted. In such cases the sketch, with the written work order, has the merit of eliminating time losses incurred by having to stop a machinist who may be ma-



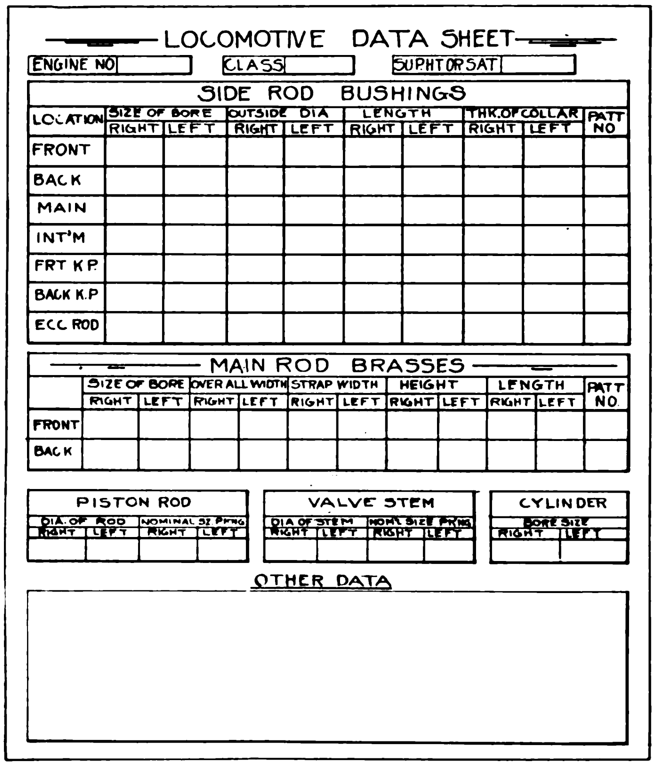
The top view shows how the sketches are grouped together for ready reference, while the lower view shows a few more sketches as well as at the right, a chart showing the material bin numbers and their contents, and at the extreme right an index to the material chart which gives the name of the piece, class of locomotive used on, sketch sheet number and bin number

chining or repairing a part, in order to explain to the apprentice the work to be done on some of these stock parts.

The system, in addition to eliminating interruptions in the progress of the work, leaves no excuse for loafing. It furnishes a means also of checking up on the man who would "stall" or lacks the spirit of sincerity in his work. In having the work to continue in this definite systematic way, there is an advantage of keeping in touch at all times with the progress of operation of each piece under way, and with the line up that follows.

In the small shop with limited equipment, where the distribution of work must of necessity be rearranged as incoming running repairs develop, the method proves very satisfactory. The foreman merely rearranges the order of the work slips according to the erecting shop or engine-house requirements.

In addition to locomotive repair part sketches, the individual locomotive data sheet shown in the illustration is of much service to the machinist. It contains the di-



LOCOMOTIVE DATA SHEET

ENGINE NO. ___ CLASS ___ SUPHT OR SAT ___

SIDE ROD BUSHINGS

LOCATION	SIZE OF BORE RIGHT	SIZE OF BORE LEFT	OUTSIDE DIA RIGHT	OUTSIDE DIA LEFT	LENGTH RIGHT	LENGTH LEFT	THK. OF COLLAR RIGHT	THK. OF COLLAR LEFT	PATT NO
FRONT									
BACK									
MAIN									
INT'M									
FRT K.P.									
BACK K.P.									
ECC ROD									

MAIN ROD BRASSES

	SIZE OF BORE RIGHT	SIZE OF BORE LEFT	OVER ALL WIDTH RIGHT	OVER ALL WIDTH LEFT	STRAP WIDTH RIGHT	STRAP WIDTH LEFT	HEIGHT RIGHT	HEIGHT LEFT	LENGTH RIGHT	LENGTH LEFT	PATT NO.
FRONT											
BACK											

PISTON ROD

DIA. OF ROD RIGHT	DIA. OF ROD LEFT	NOMINAL SZ PKNG RIGHT	NOMINAL SZ PKNG LEFT

VALVE STEM

DIA OF STEM RIGHT	DIA OF STEM LEFT	NOM'L SIZE PKNG RIGHT	NOM'L SIZE PKNG LEFT

CYLINDER

BORE SIZE RIGHT	BORE SIZE LEFT

OTHER DATA

This data sheet is filled out and given to the machinist as a guide for making repairs

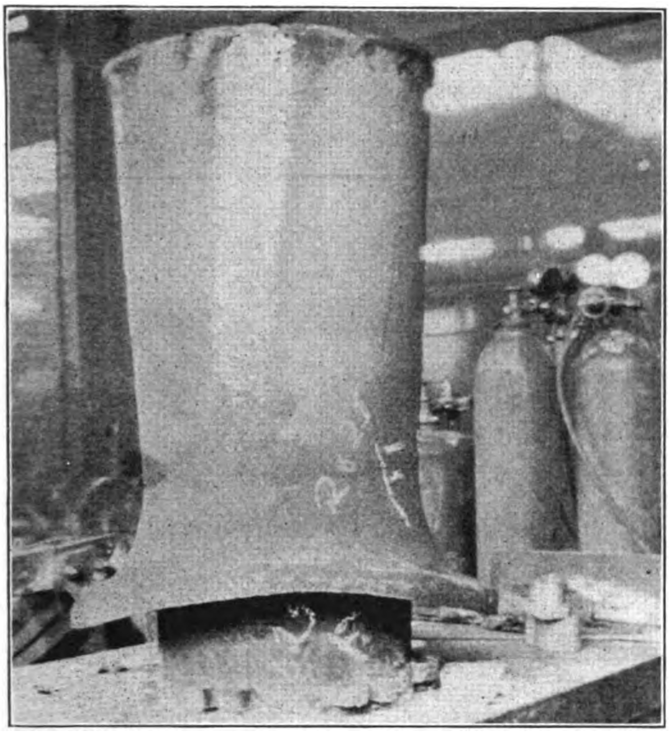
mensions to which the parts designated on the data sheet are to be finished, thus eliminating the practice of the operator leaving his machine to secure dimensions. Another illustration shows a condensed tabulation of castings with their pattern numbers as well as certain characteristics of all classes of locomotives. Where many classes are used, the compilation of such a condensed table is rather tedious. However, the frequent use to which it is put makes the time spent fully worth while.

IRON AND WOOD FLOORS in railway wagons may be replaced by cement, if experiments recently conducted in Germany continue to prove successful. According to a report by the United States Consul-General at Frankfort-on-Main, a reinforced concrete composition has been used in the construction of the floors of railway cars with a great measure of success. The first car made of this substance was built in 1919 at Heidelberg, and was tested in the railway yards. The car withstood concussion at a speed of 16.5 miles, and shifting tests were so satisfactory that after five years of service, this test car still remains in perfect condition. The new type of car weighs 20 tons and in appearance is much the same as an ordinary iron one. The cost of manufacture, however, is much less than for iron, and although the concrete car is much heavier, the fact that the danger of rust is eliminated offsets this disadvantage. The car with concrete floor requires so little repair work in comparison with wood and iron cars that the railway administration is favorably impressed since the yearly expenditure for repairs on the old type of car reaches a considerable amount. A company for the manufacture of these cars has been formed at Darmstadt.

Welding with Tobin bronze

Use of a mild heat facilitates making welds on cast iron—No pre-heating is required

MANY railroad shops have been using Tobin bronze quite extensively during the past few years for welding locomotive parts that would require dismantling if any other kind of welding rod was used. This development in welding work has created considerable discussion as to the merits of Tobin bronze as compared to cast iron and steel. The Wabash has performed a number of successful repair jobs in its shops, photographs of some of which are used to illustrate this article. The American Welding Society has devoted considerable attention to the development of Tobin bronze welding and a number of papers have been presented on that subject before various sectional meetings of the society during the past year. Following is an abstract of a paper presented by S. W. Miller, consulting engineer, Union Carbon and Carbide Research Laboratories, New York, before the December, 1924, meeting of the Boston, Mass., section.



Smoke Stack welded with Tobin bronze to avoid preheating

Welding cast iron with bronze

By S. W. Miller

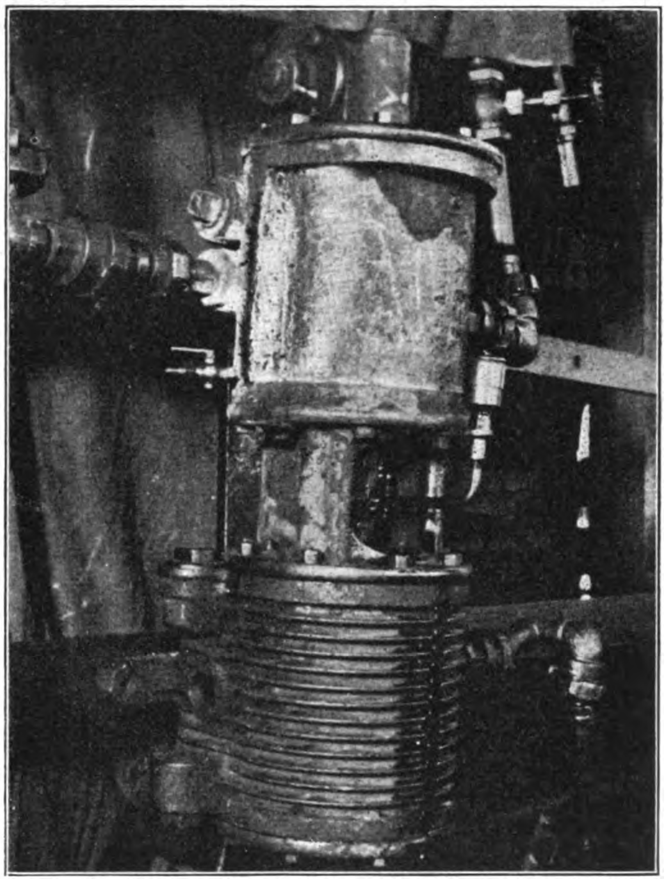
Consulting engineer, Union Carbon & Carbide Research Laboratories, New York

At first sight, welding cast iron with bronze does not seem to be a very promising process. The softness of bronze compared with that of cast iron and the quite general belief that bronze is deficient in strength, would lead one to believe that the chances for success were comparatively small. But, when we consider the facts we can easily see that there are good reasons for the success and wide application of this method used for joining cast iron.

The bronze used for this purpose is not real bronze. It is not a copper-tin alloy, but a copper-zinc alloy. Furthermore, it is not ordinary brass, but contains iron, manganese and tin, varying amounts of one or more of these elements being present. The composition usually falls in the following range:

Copper	57 to 62 per cent
Zinc	38 to 41 per cent
Iron	up to 1.0 per cent
Manganese	up to 0.5 per cent
Tin	up to 1.0 per cent

From this it will be seen that the composition must be restricted rather closely. The iron strengthens the alloy, the manganese helps in making a sound weld, while the tin increases the fluidity. It is essential that aluminum and lead be kept out as the former prevents the bronze from joining with the cast iron, while the lead makes a porous weld.



Air compressor welded with Tobin bronze without being removed from the locomotive—The break was vertical to the steam passage to the left of the casting

The advantages of the bronze welding processes are: First, its rapidity; second, only a small amount of preheating need be used; third, the ductility of the bronze absorbs and reduces to a safe point welding strains that would cause breakage with cast iron welding; fourth, the greater strength of the bronze makes it possible to use

only small amounts when the weld design is correct; fifth, the low melting point of the bronze and its easy union with the cast iron, makes it possible to apply without melting the base metal.

Its only disadvantage is its ductility or rather its low yield point, which makes it unsuitable for use where rigidity is needed. Even in such cases it is sometimes possible to use bronze if the unit stress is not too great. It may also be said that different alloys used for bronze welding rods have different shaped stress-strain curves, some of them having a rather definite yield point, as does steel. Such alloys behave in an elastic manner and acquire no permanent set under safe loads.

The uses to which the bronze welding process may be put may be divided into two classes: where stress is needed, and where a bearing surface must be provided.

The usual method of fusion welding requires a vee between the pieces joined. This is gradually filled up with the weld metal which is fused to the sides of the vee during welding. Thus, the strength of the welded piece depends on the strength of the union between the weld and base metals. Where bronze is vee-welded to ordinary cast iron and the joint is tested in tension, the break is always in the cast iron because it is the weaker. This is, of course, where the sections are equal. Any defect in the union makes the joint less efficient. It is also evident that when the vee is filled up, the maximum tensile strength is obtained. It is possible, however, to make a joint always of greater strength than the cast iron by using the shearing strength of the union between the two metals. There is no limit to the length of the weld so the shearing strength may be made anything desired. The tensile strength depends on the thickness of the weld and this can easily be made ample.

Welding with Tobin bronze on the Wabash

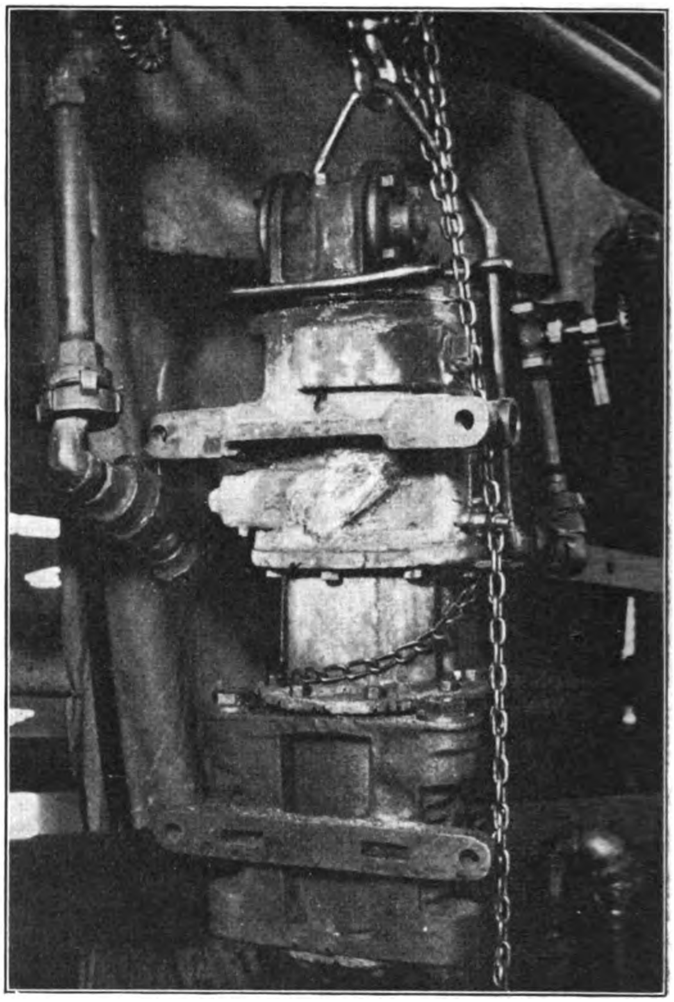
By James A. Heaton

Welding supervisor, Wabash, Decatur, Ill.

Before Tobin bronze was used in railroad shops, it was customary to weld all iron castings with cast iron welding rods. This usually required dismantling of the part to be welded so that it could be pre-heated. This was necessary, for when welding with cast iron, the base metal had to be raised to fusion heat so that the base and weld metals would be completely welded together. It is still considered good practice to weld many castings in this manner, despite the time and trouble required to dismount and pre-heat them. There are, however, some castings on a locomotive which can be satisfactorily welded in position without dismounting or removing the internal part.

This class of work is shown in the two illustrations of the air pumps. In one case, the break occurred in the steam cylinder in the rear of the casting. In repairing this break, the pump was removed from the brackets and placed on the running board of the locomotive. The break was chipped out and all the metal within two inches of the break was thoroughly cleaned. The steam line was then attached to the pump and allowed to remain open for 20 minutes, when the steam was shut off. Welding with Tobin bronze filler rods was begun immediately; a total of 10 minutes being required to complete the weld. The Tobin bronze welding rods, heated and dipped in powdered flux, were used to "tin" the surface of the cast iron with bronze. The bronze flows freely and spreads out over the clean metal surface forming a thin film. After the "tinning" process was completed, the bronze was built up until the break was completely filled, care being taken to manipulate the torch so that neither the cast iron or the bronze were overheated.

In such work the base metal must not become too hot, but should become sufficiently heated so that the bronze will run freely and adhere to it. It should be kept in mind that the melting temperature of Tobin bronze is approximately 1,650 deg. F., while that of cast iron is about 2,300 deg. F. After the work of welding was completed, the pump was allowed to cool down to the temperature of the steam. The steam was again turned into the pump for about 20 minutes after which time the pipe was disconnected and the pump replaced on the brackets ready for service. The entire time consumed on this job was 1 hr. 20 min. So far as the work of welding was concerned,



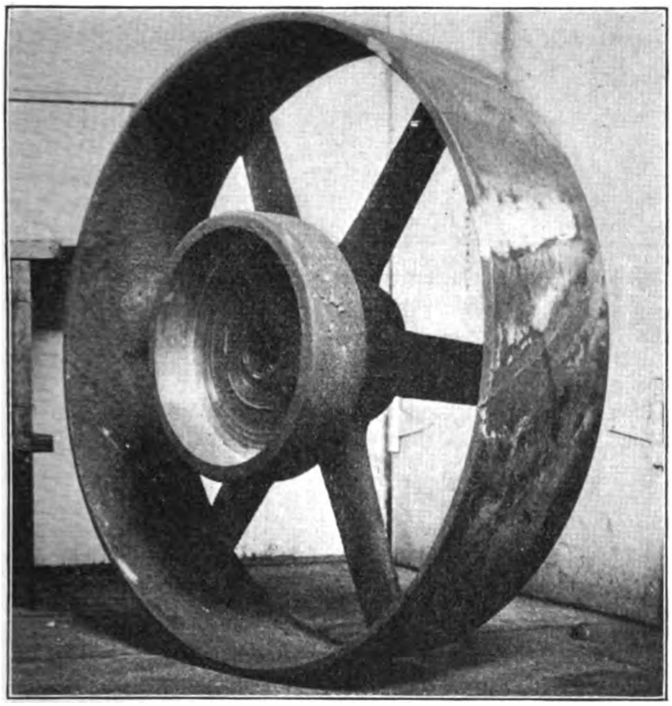
In repairing a break in the steam cylinder at the rear of the casting, this air compressor was removed from the brackets and placed on the running board

it would have been unnecessary to remove the pump from the brackets except that the break occurred in the rear of the pump where it was inaccessible.

The second pump which is also shown in one of the illustrations was repaired without being removed from the brackets. The break was vertical at the steam passage to the left of the casting. The welding work on this job was performed in practically the same manner as described for the first pump.

Another repair job performed with Tobin bronze filler rods is the 36-in. cast iron pulley, views of which are shown in two of the illustrations. The width across the face of this pulley is 10 in. The broken piece in the rim was 18 in. in length on one side and 12 in. on the other.

There was also a break in the center of the broken piece extending three-quarters of the distance cross the face. There were, therefore, three breaks to be welded. This job could have been accomplished with cast iron filler rods but this would have required pre-heating. The edges of the broken part of the rim of the wheel were beveled to an angle of 90 deg. An opening of about 1/8 in. was left to allow for expansion. Plates were placed on the inside and held in position by means of clamps as shown in one of the illustrations. These clamps held the broken part in line with the rim during the process of welding. The break in the center of the base was not beveled or expanded in any way until the welds at each end had been completed.



A 36-in. cast iron pulley welded with Tobin bronze—The broken piece in the rim was 18 in. long on one side and 12 in. on the other, with a crack in the center extending three-fourths of the distance across the face

After welding the two end breaks, the casting was allowed to cool down and it was found that the center break had opened one inch further. The center break was chipped out to an angle of 90 deg. and welded with Tobin bronze. The casting was then allowed to cool and the welds were ground with a portable emery wheel to the coutour of the rim.

This job was completed in six hours including the work of welding and the time required for cooling. One man performed all of the work. If this job had been done with cast iron filler rods, it would have taken this time properly to pre-heat the pulley and two men would have been required to complete the work.

Another example of bronze welding is shown in the illustration of the smoke stack. This job did not involve the removal of parts, but the object in welding with Tobin bronze was to avoid pre-heating. The smoke stack which was badly cracked could have been welded just as well on the locomotive. But, as the locomotive had come into the shop for classified repairs, it was necessary to remove the stack. If the welding had been done while the stack was on the locomotive, an additional advantage would have been gained, because, the work could have been done while the fire was in the boiler and the heat would have kept the stack casting from cooling too rapidly. As it was, the casting was removed and placed on a work table as shown in the illustration. The break was beveled to 90 deg. and the metal cleaned off two inches on either side. A 3/16-in. or 1/4-in. diameter Tobin bronze filler rod, 36-in. in length is the best adapted to this kind of work. The flux was applied by heating the bronze rod, dipping it into the flux box and applying the flux coated rod in the weld. The flux used in this case was a good grade of brazing flux in the form of a powder.

The term "brazing" is often applied to this operation, but bronze welding is believed to be a better term. If a Tobin bronze weld is cut open with a saw, the weld metal will be found to have mingled with the base metal, producing a union between the two. When this condition exists, the term "welding" seems to apply more accurately than the term "brazing." As an illustration a shaving 32 ft. long was taken from a piston head that had been welded with Tobin bronze. This shaving did not show any blow holes or porosity and returned to its original shape when stretched.

Owing to its high tensile strength, and its ability to withstand strain with heavy loads, Tobin bronze is being used quite extensively in these shops on machine parts such as rebuilding gear teeth, broken chucks and repairing tools. In a locomotive shop where taps are used by nearly everyone, regardless of whether or not they understand how to use them, the wrench fit will be worn round or the taps sometimes broken when not reversed to allow the cut metal to drop out of the teeth. To offset this difficulty, an extension of mild steel is brazed on the tap. When an extra strain is given the tap, this extension will twist which indicates to the operator that something is wrong. The writer has seen extensions which have twisted off leaving the brazing intact.

Our experience on the Wabash has shown that the average cast iron welder needs a little special training in the handling of Tobin bronze, in order to accomplish good work, particularly where the weld is vertical.

Welding with Tobin bronze *

By W. C. Swift

Research engineer, Anaconda Copper Mining Company, New York

When one stops to compare the processes of welding with Tobin bronze and welding with steel or cast iron, it is soon evident that the two processes have little in common other than the preliminary careful cleaning of the weld areas of the base material. In welding with Tobin bronze, it is absolutely essential that the mill scale on rolled or drawn steel, unless rusted away, should be ground or filed off. It is advisable to apply the heat a little back from the joint and let it flow evenly to the entire surface of the vee, taking care that the weld areas are not heated at any time above a dull red. A good flux should be used and in making a large Tobin bronze weld, the weld areas should be "tinned" with the Tobin bronze, and bronze then added to complete the weld. It is essential that the cone of the oxy-acetylene flame be kept away from the Tobin bronze, otherwise the bronze will burn quickly and weaken the weld.

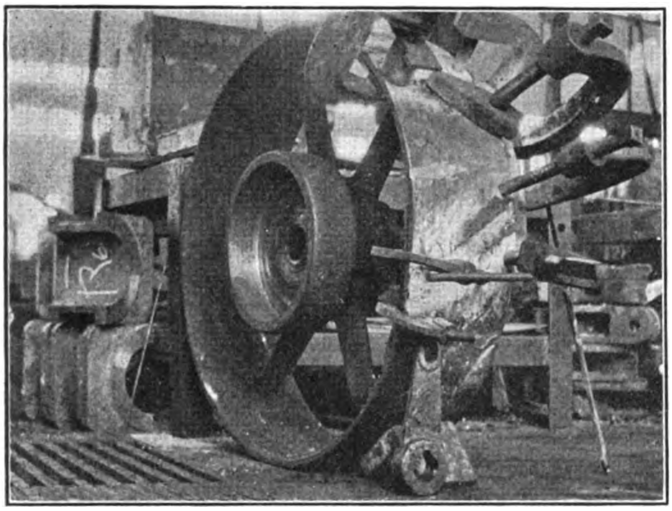
Welding with steel and cast iron is based on the principle of fusion of the weld areas with the base material. Welding with Tobin bronze is based on the principle of surface alloying a fused dissimilar filler material with the base materials which are heated to a dull red only. The reader will note that these principles are different in each essential respect and that is the reason why one meets so many welders who tell you they have tried to weld with

*Abstract of paper presented at the May, 1925, meeting of the New York section of the American Welding Society.

Tobin bronze but have had no success. The reason they have had no success is that they have tried to weld with Tobin bronze just exactly as they would weld with steel or cast iron. It can not be done.

It is becoming quite common in railroad repair shops to weld locomotive cylinders in place with Tobin bronze. As Toben bronze is about three times as strong as cast iron, it is possible to use proportionately less of the bronze. Anything breaks at its weak spot, so if the weak spot can be made three times as strong as at first, it is a great advantage. Furthermore, if the weld can be made without pre-heating and in one-third or less the usual time and have a joint three times as strong and one that will not rust, why not weld with Tobin bronze?

Steel can be welded with Tobin bronze in about one-half to one-fourth the time required to make a weld with



Another view of the 36-in. cast iron pulley, showing how the clamps were applied to hold the broken part in line while being welded

steel. The Tobin bronze weld is as strong as the steel weld; there is no injury to the base metal and little, if any, warping or pulling out of line.

In welding galvanized iron with Tobin bronze, welds are made very rapidly with no burning of the galvanized coating; the welds will not rust and are practically non-corrosive. Practically every article, except aluminum, brought to a welding shop can be welded with Tobin bronze.

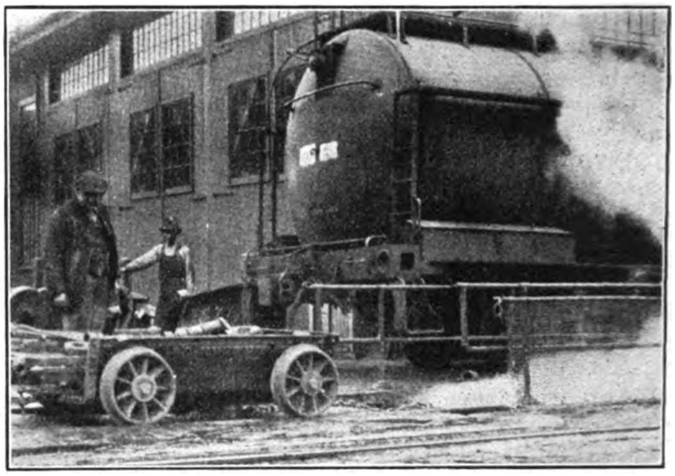
Welding electrically with phosphor bronze is making rapid progress and the developments of the future seem to promise almost as great advantages for this process as have been proved in welding by the oxy-acetylene process with Tobin bronze.

Lye pit for cleaning locomotive parts

By Charles W. Geiger

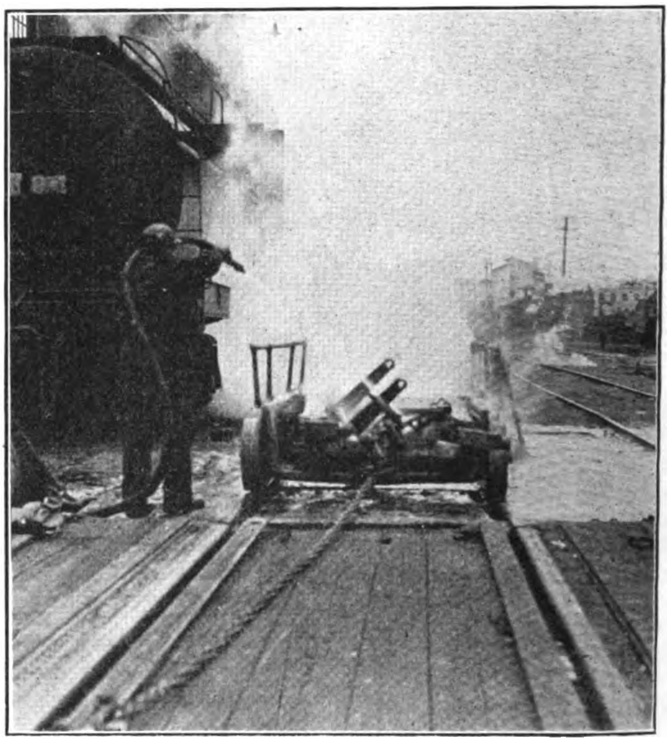
THE lye pit illustrated is located at the general repair shops of the Southern Pacific, Sacramento, California. It is constructed so that the top of the pit is level with the shop tracks and is provided with hand rails on both sides. The parts to be cleaned are placed in a four-wheel truck equipped with a steel body, which is punched with holes so that the lye water is drained off when the truck is pulled from the pit.

The system used for cleaning locomotive parts in these shops is quite simple and efficient. The truck is placed, adjacent to the locomotive in the erecting shop and as each part to be cleaned is removed it is placed in the truck. After this work is completed, the loaded truck is pushed onto the transfer table which takes it to the track leading to the lye pit. The end of the lye pit toward the



View showing the truck standing at the top of the incline lead-into the lye pit

transfer table is built with an incline and the track runs directly down the incline to the bottom of the pit. The loaded truck is pushed off the transfer table and is attached to a cable as shown in the illustration. It is then



The truck load of parts is removed from the pit by means of a cable attached to the drum of the transfer table

pushed to the top of the incline and allowed to run down to the bottom of the pit.

After the parts have been submerged in the hot solution for the required period the truck is then pulled up the incline out of the pit by attaching the cable to the drum cable of the transfer table. The solution is heated by steam pipes installed in the pit. After the truckload of parts has been removed from the pit a workman washes them off with a stream of water.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Laying out crown brasses

PORT ARTHUR, Ont.

TO THE EDITOR:

After the press fit has been turned on a driving box crown brass, the two edges must be laid out preparatory to machining to fit the driving box. The method we use is to stand the new brass on end on the driving box and line it up, as near as possible, with the end contour of the box. The lines are then scribed on the end of the brass with a scriber held flat against the lip on the driving box. This method is very unsatisfactory because of the great variation in the pressure required to press the brasses in the boxes.

I would like to receive some suggestions as to a more accurate method of laying out these brasses.

A CONSTANT READER.

Apprentices neglected

HAMMOND, Ind.

TO THE EDITOR:

The writer has always felt a keen interest in railroad apprenticeship systems and has read carefully all the articles to which he has had access dealing with the training of railroad apprentices.

Observation of methods of handling the apprenticeship question on a number of roads leads one to believe that some are making an honest effort to benefit themselves by training apprentices in four years' time to become skilled mechanics and later graduating to be officers.

On other roads it seems that they have apprentices simply because their craft agreements permit a certain quota of apprentices. Such apprentices are often treated as in the nature of a necessary evil rather than as an asset—a well trained apprentice is surely an asset to any railway.

I recall one large system that provided night schools with capable instructors for the benefit of the shop apprentices. Another system, equally as well known, turned the boys loose to the tender mercies of a mechanic. Would it be hard to hazard a guess as to which railroad turns out a graduate at the end of four years of the most value to itself and to the boy?

Another large system maintained at a number of shop points, for the special benefit of car department apprentices, several tracks on which the apprentices, under the direction of a skilled supervisor, rebuilt wrecked cars of various types, making templates and patterns from drawings, thus securing good practical knowledge of car construction and a working knowledge in reading blue prints.

Still another road gives the apprentices four hours' instruction per week in mechanical drawing and arithmetic. It has been noticed that in the grading, which is done jointly by the apprentice instructor and shop foreman, very often the boy who grades high on shop work is low in school work, and vice versa. I have often wondered if this was caused by trying to fit "a round peg into a square hole."

Nearly all agreements with shop crafts covering the employment of apprentices have "aptitude" clauses stating that, "If after a specified period of time the apprentice shows no aptitude for the work, he shall be dismissed." This rule should be more carefully observed and strictly enforced. An examination covering the apprentice's inclination to learn, his fitness for the work, and his desirability from the company's viewpoint, should be given, and if the boy fails, he should make way for another.

Frequently the foreman does not place the boy with a mechanic possessing the class or temperament of an instructor. It is seldom "the blind can lead the blind" and it is injustice to place an apprentice with an inferior or temperamental mechanic and expect to attain results.

H. R. RICE.

College men in the mechanical department

STATE COLLEGE, Pa.

TO THE EDITOR:

In your February issue, the leading editorial under the above caption discusses briefly, but to the point, a question which is uppermost alike in the minds of railroad officers and college teachers and administrators. The next step would seem to be to bring together representatives of each of the parties concerned.

May I suggest the following for consideration?

1—Set aside a session at the June meeting of the Mechanical Division of the American Railway Association, for a carefully prepared survey of the present situation. Let the men chosen for this task be familiar with both angles of the question. These papers should present an analysis of the problem rather than give a general discussion.

2—Follow this with an open discussion in which all the cards are laid on the table. At least 25 representative heads of railway mechanical departments, and deans should be invited to attend.

3—Appoint a joint committee before the meeting or early in the proceedings which should meet during the convention and report back before adjournment. If possible, they should prepare a definite working plan for both the colleges and the railroads, to meet present needs.

4—Give the plan a fair trial for two years, and based on the experience of the proposals, prepare a more permanent program.

If, this, or a better plan is not carried out, there is grave danger that the railroads will continue to lose some of the best engineering graduates.

In venturing to suggest the above definite plan, it is assumed that the railroads are not satisfied with present conditions. Unless sufficient attention is given to a better understanding, no adequate solution may be expected.

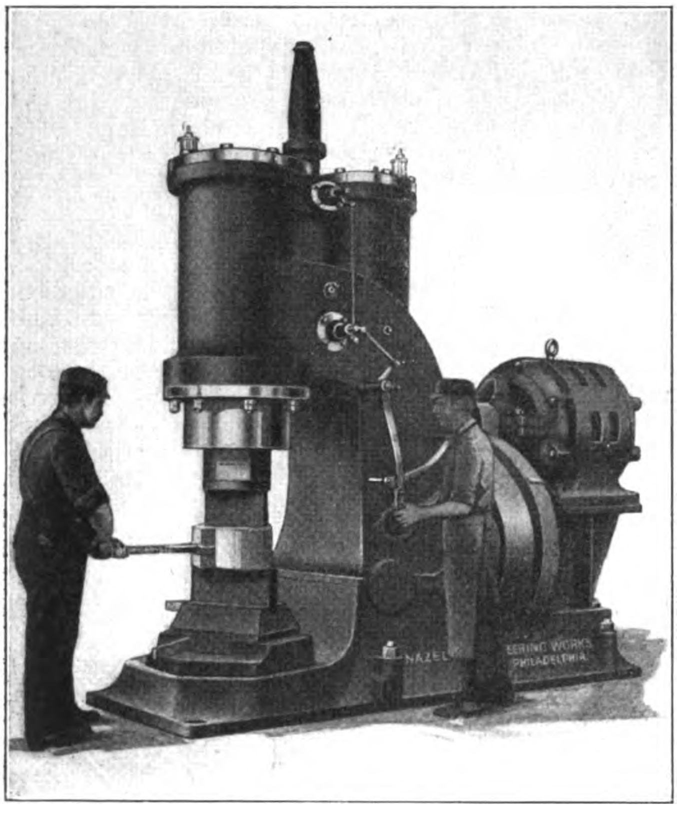
From my contact with many railroad men and with hundreds of mechanical graduates, I regret to observe that the gap is growing wider, and it will not be bridged until both sides get together and agree on questions of recruiting and training.

The engineering schools are now waiting to see if the railroads are sufficiently interested to co-operate actively.

A. J. WOOD,
Head, Department of Mechanical Engineering,
The Pennsylvania State College.

Self-contained air operated forging hammer

A SELF-CONTAINED air operated forging hammer has been placed on the market by the Nazel Engineering & Machine Works, 4041 N. Fifth street, Philadelphia, Pa. It is a combined hammer



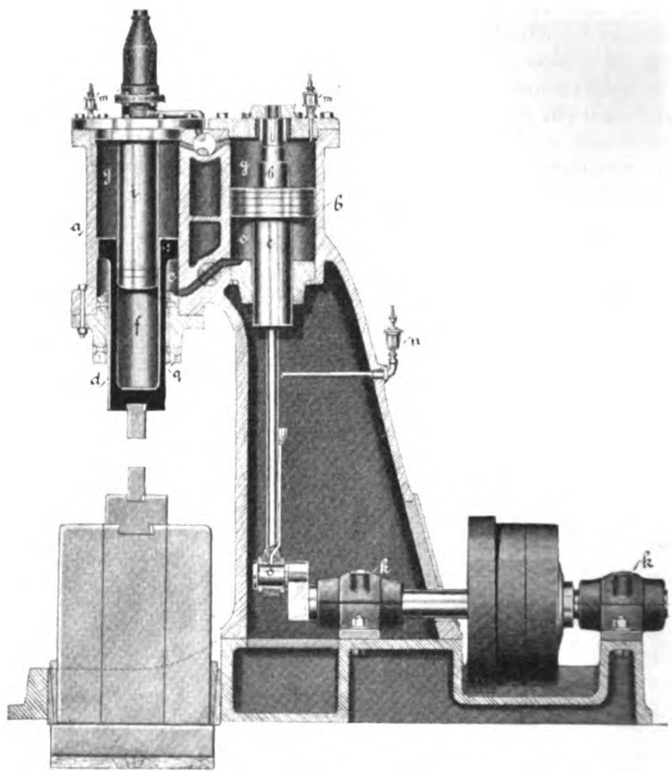
Type B motor driven, air operated, hammer with a ram stroke of 27¾ in.

and compressor which uses the air at the temperature which it attains in compression, and as its expansion is almost perfect, it gives up nearly the full power that is put into it in compression.

There are two separate cylinders, cast integral, one in which the piston operates, actuated by a connecting rod attached to the crankshaft, which in turn, revolves with each revolution of the belt or a motor driven fly wheel. In the other, the ram or hammer head, sliding vertically on closely fitted guides, is operated by compressed air and vacuum influenced by the double acting piston in the opposite cylinder.

The ram or hammer head is a hollow forging of special alloy steel, bored out of the solid and in nowise attached to any other part of the hammer.

Special importance is placed on the longest possible ram guide, which is fitted with cast iron shoes on which the ram or hammer head slides. These shoes can be



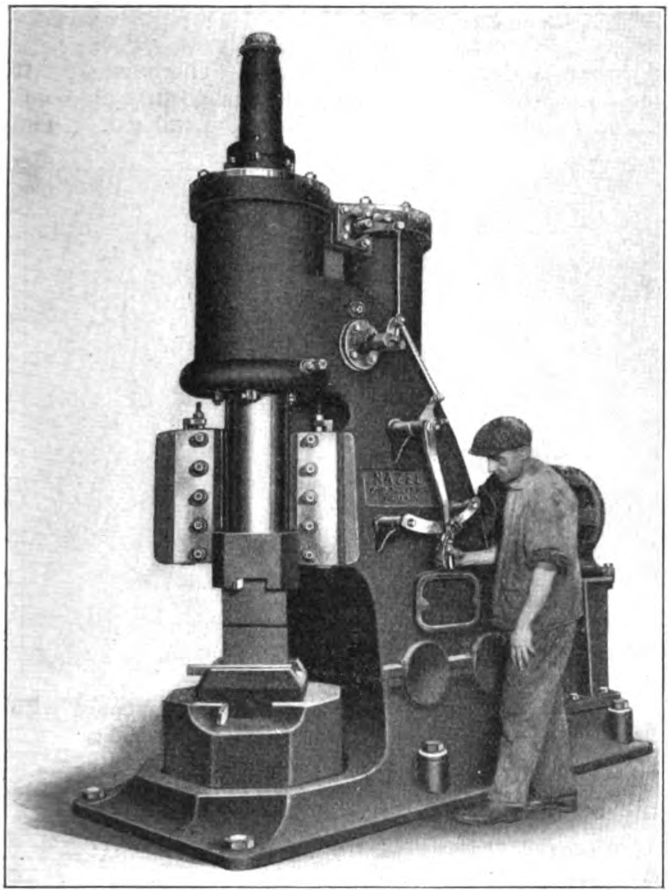
Cross-sectional view showing the construction and method of operating the Nazel air operated hammer

easily removed or relocated in several positions 45 deg. apart, should it be desired to change forging position of dies. This feature applies to the Type B hammers only, as Types N and I are fitted with adjustable V guides.

The base plate is cast in one piece and is secured to

the cylinder frame or housing by four weldless steel rings shrunk on accurately machined bosses, on the housing and base.

The anvil block is made of a special grade of grey iron and is separate from the hammer frame and base and rests independently on the foundation. The diagonal position renders the dies accessible on all sides and enables long bars to be worked in either direction across the anvil.



Nazel Type N motor driven, air operated, hammer built with 500 lb., 700 lb. and 1,250 lb. ram weights

The anvil cap or bolster is a steel casting, keyed to the anvil block above the base plate and it can be removed without disturbing the hammer. The dies are regularly furnished with flat faces for plain forging and are made of high carbon, open-hearth, steel forgings.

The Nazel hammer is controlled by two simple cylindrical valves which are operated together. After the power is turned on and the valves closed, the ram elevates and remains stationary in a suspended position, allowing free space for the operator to place the work on the lower die. When the valves are opened by means of a treadle or hand-lever, the ram begins to operate. If the valves are opened suddenly, the ram will strike a quick, hard blow. If opened gently, it will strike a light blow, the force of the blow being increased as the valves are opened further.

The method of operation and construction of the hammer can be followed by referring to the cross-sectional view in the accompanying illustration. By lowering the piston *C* the ram *D* is forced upward by the force of compressed air in chamber *E* of the ram cylinder underneath the top of the ram and by the vacuum produced by the descending piston in the chamber *G* above the ram. It is to be noted that two forces act jointly in the raising of the ram. As the piston *C* ascends, the suspended ram *D* is driven down by the force of the compressed air in chamber *G* above the ram and the vacuum in the chamber *E* underneath the top of the ram. These two forces are augmented by the compression in the inner ram chamber *F* which is created by the force of the ascending ram.

The hammer starts immediately as soon as the power is turned on and maintains a uniform speed at all times, variable blows being obtained instantly at the will of the operator without interruption or adjustments of any kind.

The hammer can be belt driven irrespective of the direction of rotation and the belt shifter is interchangeable to either side of the hammer. As the load is of a fluctuating nature, it is desirable that the drive should be as direct as possible. For this reason the hammers are equipped with a tight and loose pulley, thus eliminating the use of countershafts. As the drive must be capable of transmitting the maximum power given under the specifications covering the respective size of hammers, it is recommended that the double belting be used.

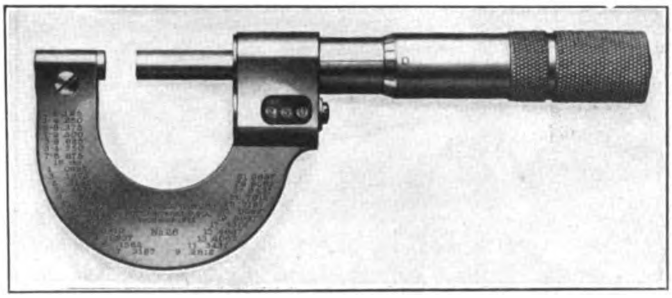
The hammers are also arranged for motor drive, either geared or belted and may be obtained complete with the motor. Any type of constant speed motor can be used but the speeds should be under rather than over those specified so as to permit the use of as large a pulley as possible.

Direct reading micrometer caliper

READING the setting an ordinary micrometer has always been more or less difficult because all the .001-in. marks on the barrel can not be seen at one time and these marks are necessarily so small that under adverse lighting conditions they cannot be seen easily. These conditions are more or less conducive to errors in making a reading. The Brown & Sharpe Manufacturing Company have recently placed on the market a micrometer on which the setting can be read directly from a dial.

The construction of the micrometer is substantial throughout. Particular attention has been given to the indexing mechanism to insure long life and dependability. Steel indexing gears are used, insuring good wearing qualities and smooth action.

The micrometer can be easily held and operated with one hand. The dials are large and can be read at a glance from any angle. Simple means for the adjustment of the measuring screw are provided. When it is necessary



Micrometer caliper which can be read at a glance

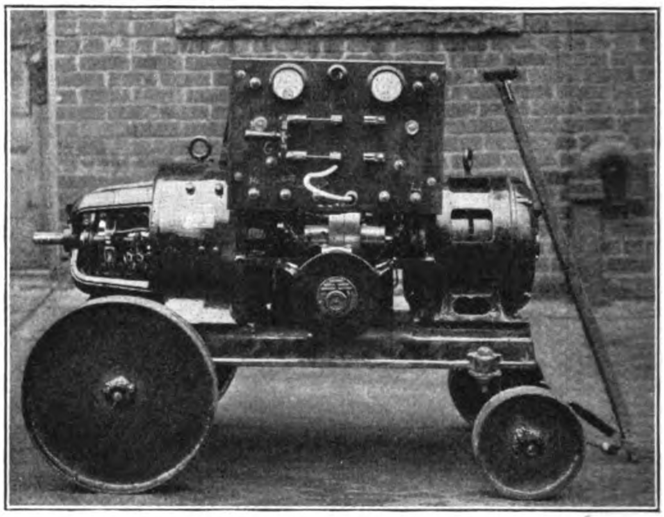
to compensate for the wear of the measuring screw, a cap on the end of the thimble is removed and the adjusting nut is accessible through an opening in the thimble. This construction is advantageous as it is not necessary to dissemble the tool or return it to the factory for adjustment.

Dual current welding generator

A GENERATOR designed to develop both alternating and direct current for arc welding purposes has recently been developed by the Electric Arc Cutting & Welding Company, Newark, N. J. The machine is being marketed under the name of "Dualarc" generator, and it is built by the designers to meet the demand for a single machine which will embody all of the advantages which have been attributed to both a.c. and d.c. arc welding. The entire apparatus has but one involving unit which is ball bearing and may be driven by any form of power motor, or by any available line shaft delivering from five to 7½ hp.

The entire set is guaranteed to operate continuously for all arc welding without vibration. It is possible to short circuit the generator without injury, as the voltage simply falls to a low value holding the maximum current constant. It can be left in this short circuited condition indefinitely without injury. The field coils are so arranged that they may be connected either as series compound or series differential so that both carbon arc and metallic arc requirements are provided for. The machine is not separately excited. The field windings are wound on steel bobbins and baked solid in enamel before being mounted rigidly on the poles. The poles are then mounted rigidly in the frame and disassembly can be made in the same manner.

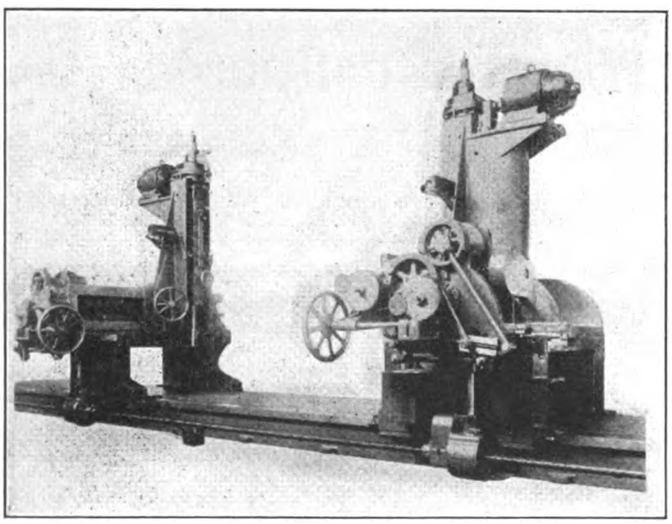
The armature is one complete baked unit with d.c. commutator and a. c. collector rings interval, each ball bearing and frame is demountable separably. There is a shaft extension on both ends of the generator so that air compressors or other power take-off can be utilized. The generator will operate in either direction and the voltage and current are adjustable independently.



Combination a. c. and d. c. welding generator equipped with motor drive and mounted on truck for portability

Two head locomotive frame slotter

THE Betts Works of the Consolidated Machine Tool Corporation, Rochester, N. Y., has recently placed on the market a line of locomotive frame slotting machines the yokes of which are driven by separate motors. The illustration shows one of these machines equipped with two heads, but they are also furnished with one or three heads, as required.



Each yoke of this locomotive frame slotter is driven by a separate motor

This machine is simple in design and construction. A minimum number of working parts are employed, full advantage being taken of electrical action for driving, feeding and traversing, instead of using mechanical means for these operations. The width between the yokes, height under the yokes, length of bed and the travel of the slotting rams are arranged to meet the special requirements of the user. The height and length of the stroke is arranged to permit the slotting of the frame in multiple.

The bed consists of a wide, deep casting with long narrow guiding surfaces for yokes. The faces on which the yokes bear, are chilled so that they have a hard smooth surface. The top is provided with suitable T-slots for clamping the work. Both sides of the bed are equipped with stationary lead-screws, the yokes are moved by means of revolving nuts which engage with them. The lead-screws have tumbler bearings which prevent sagging. The thrust is taken by roller bearings.

Each yoke has a separate electric feed and power rapid traverse along the bed, and are driven by a single motor mounted on each yoke. The yokes also have a fine hand adjustment by means of a large handwheel within the reach of the operator from the floor.

The crossrails are arranged with either a hand or power swiveling movement for angular slotting. Each saddle

has electric feed and power rapid traverse. as well as hand adjustment along the crossrail. The motor driving the feed and power rapid traverse to the yoke performs the same functions for the saddles. Both the yoke and saddle-feed may be engaged simultaneously for angular slotting. The feed is adjusted by means of graduated feed plates located conveniently for the operator and are accessible from the floor. Independent feed to yoke and saddle is provided.

Each ram is driven by a 20-hp. reversing motor with a high return speed ratio. The cutting and return speeds are independently adjustable by means of separate rheostats for each which give a wide range of speeds. Push button control for starting, stopping, reversing, inching, etc., is available for all motors.

The rams are counterbalanced by sliding weights suspended by steel cables, and are entirely self contained. They are driven through spiral bevel gears driving a rotating screw meshing with a bronze nut, with provision for taking up the wear. A mechanical knockout device is provided to prevent overtravel. The length of the stroke is determined by means of adjustable dogs which operate a master switch controlling the driving motor.

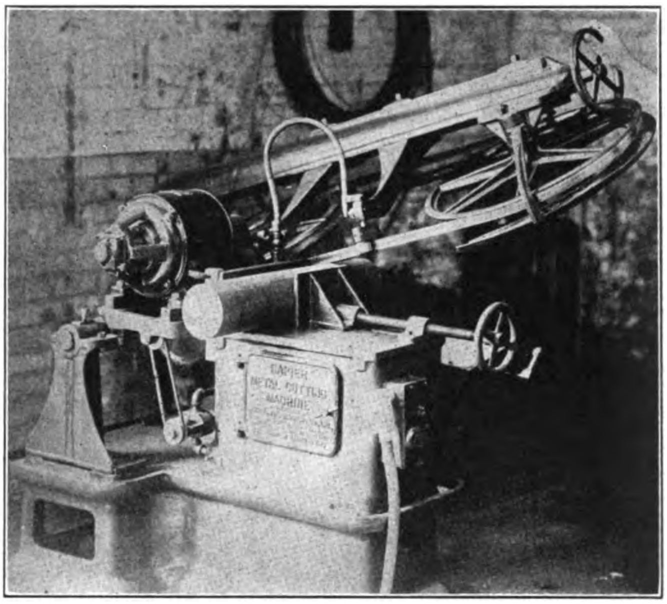
The important saddle bearings are supplied with oil by means of an adjustable automatic pump, with a feeder pipe to each bearing.

Horizontal metal cutting band saw

A CUTTING head or arm which, by its own weight feeds the saw into the work instead of the usual method of feeding the work into the saw, is the unique feature of the new metal cutting band saw, a product of the Metal Saw and Machine Company, Springfield, Mass. This action is made possible by the use of a horizontal instead of a vertical arm by the manufacturers of this machine.

The weight of the horizontal cutting head is counterbalanced by a powerful spring which gives an automatically variable feed pressure to care for the difference in the hardness in the piece of metal. It is claimed that this characteristic saves the band saw blade and gives a straight cut regardless of the variations in the stock. Constant attention from the operator is unnecessary. After the material is secured firmly in the vise and the cut started, the machine does the rest.

The accuracy and speed of the horizontal saw, which is driven by a Westinghouse motor, makes it desirable for high production in many industries for cutting all kinds of metal such as discs, billets, alloy steels, structural iron, cast iron, pipe, tubing, axles, brass, bronze, aluminum, duralumin, fibre, zinc and various other kinds of material.

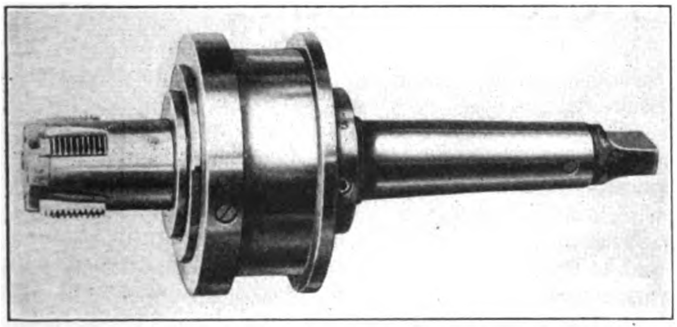


The cutting arm of horizontal Papier band saw is fed into the work by its own weight

New adjustable collapsing taps

A NEW adjustable and collapsing tap which is available in four classes, designated as S, SA, SB and SC, respectively, has recently been placed on the market by the Geometric Tool Company, New Haven, Conn.

The Class S tool, shown herewith, is of the hand machine type, having a closing handle and trip plate.



The rotary type of S B tap for automatic machines

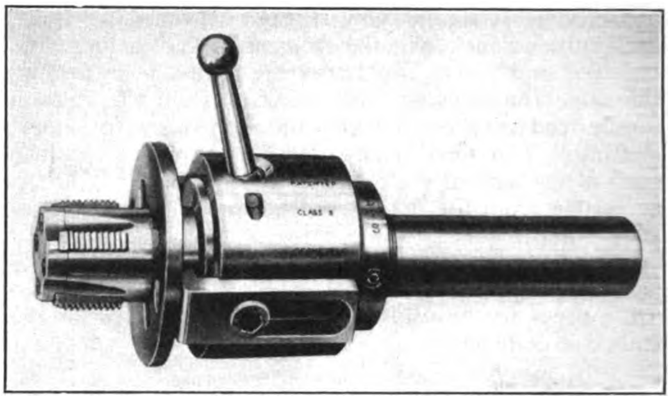
Contact with the work at the required time collapses the chasers; resetting is done by hand. The Class SA is of the rotary type with a plate trip and is the same as Class S but without the handle. Contact with the work collapses the chasers and contact of the closing sleeve resets the tap. The third class, designated as SB and also illustrated herewith, is of the rotary type with a flange trip, and is also the same as the Class S tool except that it has neither the closing handle nor the trip plate. In this tool a flange is fitted over the closing sleeve for collapsing and resetting the tap. The SC tap is of the hand trip type. It has no trip plate and is opened and reset by means of the handle.

Each of these four classes of collapsing taps is said to be convertible into the other at little or no expense. Thus, one tap with slight changes can be used on hand or automatic machines, and can be changed from plate trip to flange trip or vice versa, as well as to hand trip. The taps are made in sizes ranging from ¾ in. to 3½ in. inclusive.

The front end of the tap is of large diameter which is

claimed to increase the strength and chip clearance. Grooves milled in front of the chasers are intended to prevent the packing of chips and to permit the chasers to cut freely. The tool is of alloy steel, hardened and ground, and is enclosed for protection against dirt and chips. Another skeleton is required for left-hand tapping.

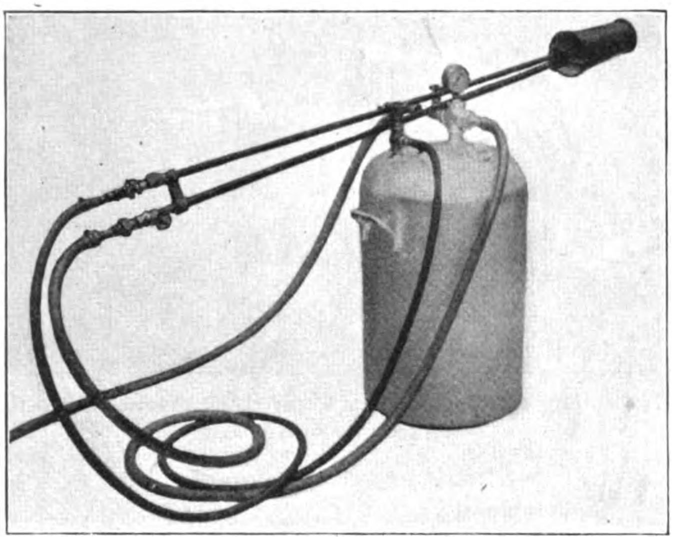
The chasers used in the four classes of S taps are interchangeable but they are not interchangeable with those used in the company's Class NL or Class H taps. The chasers are of sturdy design and because of their thickness are said to have long grinding life. Short length is a feature stressed as lending strength to the front end of the tool under the torsional stress of tapping. The chasers are of sufficient length, however, for any standard pipe thread. They are supported for their full length, which provides a bearing under the cutting point, and may be removed simply by removing the cap.



The class S tap which is the hand machine type and operated by a closing handle and trip plate

Milburn oil burner and preheater

In welding many castings, preheating is necessary to neutralize expansions and contraction strains or to effect economy of gases. Without preheating, complicated castings are liable to develop new breaks at points remote from the weld after the weld itself has been successfully completed. Large castings will absorb a large amount of heat before local melting occurs so a great gas saving can be made by preheating the entire piece.



Oil burner and preheater which can be used for many purposes

An oil burner and preheater recently placed on the market by the Alexander Milburn Company, 1418 West Baltimore Street, Baltimore, Md., is primarily designed for this work and to give maximum combustion and greatest heat in the quickest possible time, thereby resulting in greater output from men and machinery.

The burner is of the atomizing type utilizing economically the cheapest grade of crude, fuel, kerosene oil or distillate and compressed air under pressure varying from 50 to 100 lb.

The air supply line serves two purposes. While furnishing a direct flow to the burner, the air also maintains a similar pressure in the oil storage tank, creating a greater velocity in the oil feed line thus insuring a positive and uniform flow of both oil and air.

The flow of both air and oil are through straight-line orifices, unhindered by coils or staggered passages. The oil, under pressure, enters the atomizing chamber at right angles to its axis and in an annular form, while the compressed air flows directly through the center striking the filament of oil and completely atomizing it, then expanding it in a venturi-shaped outlet. A thorough mixing vortex is thus set up, producing an intimate and perfect mixture of both oil and air which insures complete consumption and maximum heating value at the flame. No particles of fuel are blown through the flame unconsumed. There is no siphoning effect of either oil or air. Immediately upon opening the valves the gas at the burner can be ignited and the work at hand can be started. It is claimed that carbonization and oxidation are eliminated in this burner.

Ball bearing electric chain hoist

The Yale & Towne Manufacturing Company, Stamford, Conn., has recently developed a ball bearing electric chain hoist known as Model 20B. It embodies such features as close headroom, long lift, higher speed, automatic top and bottom limit stops, and greater over-all strength. This hoist has high factors of safety in the strength of the load-supporting members and is designed to withstand shock loads so common to this class of equipment. All suspension members of the hoist are made of steel. The hoist can be quickly adapted to any overhead system. The side plates of the trolley carriage can be spaced on steel bars to fit the desired beam flange.

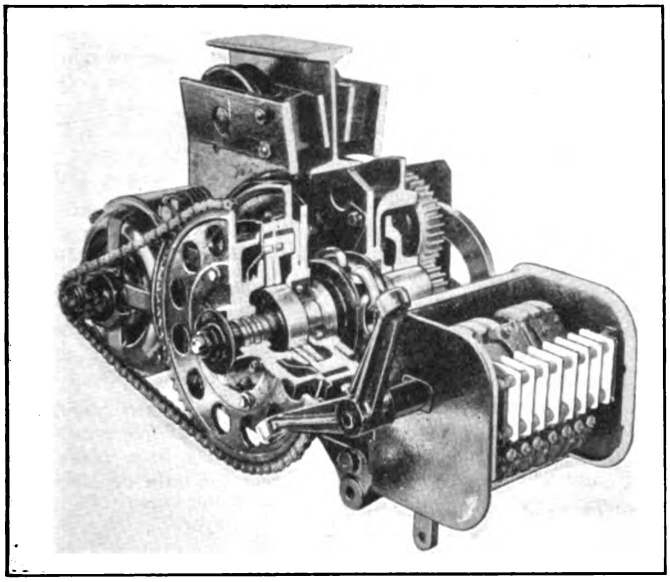
Yale electrically welded steel chain can be furnished for varying lengths of lift. The centralized steel suspension provides a constantly balanced load on the trolley wheels and hoisting unit irrespective of load position.

The mechanism is fully enclosed in oil-tight chambers and is compact and easily accessible for inspection without expert service. The large chrome vanadium steel ball bearings surrounding the steel load sheave adds a big factor for low current consumption and general all-

around hoisting efficiency. The heavy steel one-piece load sheave, ground on an arbor to give perfect concentricity for the ball races, is bronze-bushed for the driving pinion, and splash lubrication provides a continuous flow of oil over all gears, pinions and bearings. The driving pinion that passes through the load sheave is machined from a single drop forging. The bearing surfaces on the shaft are ground to .001 in.

The motor brake is operated positively by the control handle. When the current is on, the brake arms are lifted clear of the drum so that there is no dragging or friction during the hoisting operation. Immediately the current is shut off, the brake arms clamp tightly around the hoisting drum, producing a powerful, positive braking action.

The upper and lower limit safety stops are mechanically connected with the controller and operate the drum brake when the load hook has traveled its limit in either direction. The current is cut off and the brakes are applied the moment the limit of travel is reached. An upper limit stop does not in itself provide maximum safety of operation, but when combined with a lower limit stop the protection afforded is complete.



Yale ball bearing electric chain hoist with low headroom

The steel chain containers can be furnished to hold any length of slack chain up to 60 ft. for ¼, ½ and 1-ton hoists and 30 ft. for the 2-ton hoist. These containers are secured to the under frame of the hoist and do not affect the headroom.

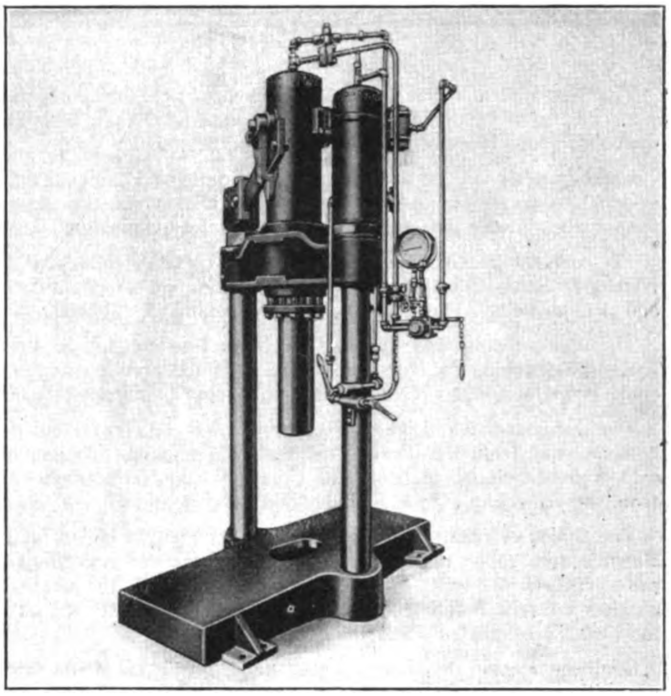
Two-rod hydro-pneumatic forcing press

A PRESS designed for operations involving forcing, pressing and bending, and adaptable more especially to railroads and other large shops has been placed on the market by the Watson-Stillman Company, 50 Church Street, New York. This press can be used for many operations of bending and straightening.

The press is of the two-rod type having the ram movement from the top downward. The ram movement is actuated by hydro-pneumatic force obtained by an air engine pump which is designed to be connected to the air line of the shop. Thus, it will be seen that the press can be operated in any shop having air pressure and does not require a motor or any other source of power.

A jib crane is provided as part of the press to facilitate handling work into and out of the press. The bottom platen is amply strong for bending with blocks on its ends up to full capacity of the press.

The valve control is simple and easily operated and a gage is provided to register in tons the pressure exerted by the ram. The press illustrated is of 100 tons capacity and the bottom platen is 72 in. long with a hole in the center to receive shafts, etc.



Watson-Stillman hydro-pneumatic 100-ton capacity forcing press

AVERAGING GOOD AND BAD YEARS.—10 to 12 per cent of all the workers in the United States, several millions of men and women, are out of work all of the time. Each year from 1,000,000 to 6,000,000 persons are out of work for weeks and sometimes for months at a time. Widespread unemployment is now a constant phenomenon with far-reaching economic, social, psychological and moral bearings. In seeking work through certain types of commercial or fee-charging employment bureaus, particularly those dealing with unskilled and casual labor, thousands of men and women are being exploited. It is claimed by the Russell Sage Foundation, New York, that public employment bureaus or exchanges can make a material contribution toward the solution of this and other phases of the ever-recurring problem of unemployment.

These are some of the points brought out in the introduction to the report of a five year study of employment methods, needs, and agencies, which has just been made public by the Russell Sage Foundation. It is brought out in the report that the figures on unemployment, while representing the average of the country's experience during the last two decades, are not necessarily indicative of present conditions or of the past year.

The investigation, which extended into more than 70 cities in 31 states and Canada, has just been completed. The full report, covering more than 600 printed pages, will be issued shortly. The survey was conducted by a staff of trained field investigators, all of whom had previously been engaged in employment work, under the direction of Shelby M. Harrison, Director of the Foundation's Department of Surveys and Exhibits.

A special study has been made of the situation in Ohio, Wisconsin, Massachusetts, and New York, where there has been the greatest development of organized public employment work.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

The shops of the Savannah & Statesboro, at Statesboro, Ga., were destroyed by fire on February 6; estimated loss, including damage to four locomotives and one coach, $25,000.

Lapel buttons will be awarded by the Southern Pacific (Pacific system) to six employees, one from each division and the general shops, who did the best work in the 1925 safety campaign.

The Central of Georgia has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of an enginehouse and storehouse at Albany, Ga., to cost approximately $100,000.

The Pennsylvania has awarded a contract to Lyman S. Peck, Inc., Philadelphia, Pa., for the extension of the erecting and machine shops at Olean, N. Y., at a cost of approximately $100,000.

The Seaboard Air Line has ordered 1,000 box cars and 800 gondola cars from the Pressed Steel Car Company, 800 gondola cars from the Standard Steel Car Company and 800 gondola cars from the American Car & Foundry Company.

The South African railways will build locomotive boilers at its Bloemfontein shops to encourage local manufacture, according to press reports. Twenty-five new freight cars and 10 passenger coaches are now building at these shops, which have turned out a total of 275 freight cars and 109 coaches.

Southern Pacific division and shop employees made 4,486 safety suggestions during 1925. Of this number, 3,248 or 72 per cent were approved and put into effect by the safety committees. Of the remainder 435 were still being considered at the end of the year.

For 20 years the railways of India and the Indian railway board have been considering the question of automatic couplers for their freight vehicles, particularly on broad gage lines. The difficulty in India that has delayed a decision in this matter lies in the necessity for designing a coupler that will meet the transition stage; that is, an automatic coupler that will join up with the existing screw coupler until the latter is displaced.

The Norfolk & Western has given copies of four reels on the rough handling of freight cars and the Illinois Central has contributed 1,000 ft. of film on the proper handling of freight in the freighthouse and on the proper inspection of cars, to a library of educational motion-picture films established by the committee on freight claim prevention, Freight Claim Division, American Railway Association. The films, which are standard gage, are available to members of the division upon application to the secretary.

According to reports compiled by the Bureau of Railway Economics, the daily average movement of freight cars during the year 1925 was 28.3 miles, the highest mark ever attained by the railroads of this country since the compilation of this information was started in 1917. This was an increase of 1½ miles over the average attained in 1924 and of ½ mile above that for 1923. It also was an increase of 3.4 miles above the average for 1920.

The average load per freight car in 1925 was 27 tons, the same as that for 1924, but nine-tenths of a ton below that for 1923. Compared with 1920, the average for 1925 was a decrease of 2.3 tons.

A unique chain letter recently reached the offices of the Canadian National in Montreal. It contains an appeal for safety first, and it has visited many countries. It touched Japan, the Scandinavian countries and various parts of Canada and the United States. The letter, which bore with it a request to the recipient that it be mailed to nine friends in various parts of the world, has been in circulation for some months, apparently having been started by an American officer and already having reached the countries mentioned above. The letter warns the recipient to cross crossings cautiously, practice safety first and "do everything in my power to save a life or prevent any injury to my fellow-men."

Fuel bill for eleven months

The railroad fuel bill for the eleven months ended with November, 1925, was $300,740,376, as compared with $324,501,011 for the corresponding period of 1924, according to the Interstate Commerce Commission's monthly statement, covering fuel for road locomotives in freight and passenger train service, charged to operating expenses, for Class I roads, excluding switching and terminal companies. The average cost of coal for the period was $2.72 per ton, as compared with $3.05 in 1924, while the average cost of fuel oil per gallon increased from 2.78 cents in 1924 to 3.15 cents in 1925. For the month of November the average cost of coal was $2.63 and the average cost of fuel oil was 2.92 cents.

Vote on interchange and car service rule changes

Interchange Rule 112 of the American Railway Association, regulating prices to be used in settlement for cars damaged or destroyed, is to remain unchanged, the proposal to modify the rule so as to provide for recognition of the rebuilt car having been voted down.

Car service Rule 4, of the American Railway Association, which provides that empty cars may be short routed at five cents a mile, is the subject of a letter ballot, which has been sent out by Secretary H. J. Forster, proposing that the rate be changed to six cents a mile beginning with April 1.

A. B. & A. Credit Union

The A. B. & A. Railroad Credit Union has been organized by officers and employees of the Atlanta, Birmingham & Atlantic for the benefit of employees of this road. It is an adjunct of the benefit association which was established by these employees about three years ago. The president of the credit union is C. E. Brower, general superintendent of transportation. The secretary is George M. Gentry, Atlanta, Ga., and the chairman of the supervisory committee is Colonel B. L. Bugg receiver of the road.

The benefit association functions not only as an indemnity fund but also includes provisions for arbitration of disputes between the railway management and the employees, being a party to a joint reviewing board. This board consists of five members elected by employees and five appointed by the management. The membership of the benefit association at present is 1,700 or 85 per cent of all the persons employed on the road. It has a reserve fund of $41,000. This fund will be taken over by the credit union.

Rail motor cars on French railroads

The relative economy of gasoline over coal as motive power, when traffic is light and infrequent, has induced various experiments in the use of motors on railroads in France, beginning in 1921 with a series of trials by the État Railway, according to Commercial Attaché Jones at Paris. In the first of these experiments an attempt was made to adapt the ordinary street auto-bus of Paris to use on railroads by a simple change of wheels. Later, specially constructed cars were ordered, and trials of these began in March, 1922.

Operations extending over 25,000 kilometers proved that motor traction is suited to certain conditions of traffic. The État ordered

10 cars, substituting an 85-horsepower engine for one of 60 horsepower employed in previous trials. These motors have been in operation since the beginning of 1925, and have covered almost 120,000 kilometers with no accidents other than minor breakdowns.

The equipment weighs 15 tons in running order. There is space for two tons of baggage and two second-class compartments for passengers. The engine can draw two 10-ton cars on easy grades, and one over steep ascents. The passenger capacity of each car is 50. The normal speed of trains is 50 kilometers an hour, the engine alone being able to reach 72 kilometers.

The degree to which this equipment may prove economical, as compared with steam equipment, is not yet fully proved, since the cars have not been in operation long enough to make possible a full estimate of upkeep and deterioration. The operation of the motor trains, it is estimated, costs about 2 francs per kilometer traveled, while the similar cost for steam locomotives is 5 francs.

New equipment installed

Class I railroads during 1925 installed in service 128,557 freight cars, according to reports filed by the carriers with the Car Service Division of the American Railway Association. This was a decrease of 27,857 cars under the number installed in 1924 and a decrease of 69,318 cars under the number installed in 1923. Of the total 61,140 were box cars, 48,670 were coal cars and 5,761 were refrigerator cars.

Freight cars installed in service during the month of December totaled 4,620, which included 1,520 box cars, 2,259 coal cars and 255 refrigerator cars.

Freight cars on order on January 1 totaled 40,794, including 21,380 box cars, 15,368 coal cars and 1,781 refrigerator cars. On January 1, 1925, Class I railroads had 55,684 freight cars on order and on January 1, 1924, they had 25,619 on order.

During 1925, Class I railroads placed in service 1,733 locomotives, as compared with 2,246 during 1924 and 4,037 in 1923. The same roads on January 1, 1926, had 471 locomotives on order as compared with 287 on January 1, 1925, and 510 on the same date in 1924. During December, 1925, 129 locomotives were installed in service.

These figures as to freight cars and locomotives include new, rebuilt and leased equipment.

Wage statistics for November

Class I railroads reported a total of 1,788,889 employees in November, 1925, a decrease of 28,149 or 1.5 per cent as compared with the returns for the previous month, according to the Interstate Commerce Commission's monthly compilation of wage statistics. Seasonal reduction in the maintenance of way forces was the principal cause of this drop in employment. The total compensation shows a decrease of $15,484,696 or 6.0 per cent, due to the reduction in the number of employees coupled with the fact that November had only 24 working days while October had 27. It is noted that the number of employees reported for the month of November, 1925, is almost exactly the same as that reported for the same month in 1924, but, owing to an increase in the number of hours worked per employee, together with an increase in the straight time hourly earnings of 0.6 cents, the total compensation shows an increase of 2.7 per cent.

The number of employees at the middle of the month was as follows:

Group	Nov., 1925	Increase over Oct., 1925	Increase over Nov., 1924
Executives, officials, and staff assistants....	16,657	72	330
Professional, clerical, and general..........	283.892	915	1,958
Maintenance of way and structures........	395,301	(d)30,346	6,009
Maintenance of equipment and stores......	521,537	1,565	(d)18,678
Transportation (other than train engines, and yard)........................	210,886	(d)1,015	1,770
Transportation (yardmasters, etc.).........	24,143	136	(d)230
Transportation (train and engine service)..	336,473	524	9,007
Total.........................	1,788,889	(d)28,149	166

(d) Decrease.

B. & O. applies piston valve cylinders to Mallets

For a number of years the Baltimore & Ohio has been experiencing trouble from cracks developing in the front and back, and extending through the port walls of the slide valve type low pressure cylinders used on some of its Mallet locomotives. In order to eliminate this trouble as well as to increase the efficiency of the low pressure engine, piston valve cylinders have been applied. According to the February, 1926, issue of the Baltimore & Ohio magazine, up to the present time there have been 22 applications of piston valve cylinders made in the Cumberland, Md., locomotive shops. At the beginning of the application of the new type cylinders, a schedule was established to change the Mallet locomotives beginning with two in January, 1925, four in February and six in March. This schedule, however, was increased to eight per month, contingent upon sufficient cylinders being furnished.

The results obtained by this change have been a noticeable decrease in maintenance and a decrease in back pressure. The new application has also practically eliminated all steam leaks and has helped to cut down the fuel consumption. The tonnage has been increased to the extent of one car per train out of Grafton, W. Va., and the time of the run on which these Mallet locomotives have been used has been decreased from between 30 min. to one hr.

Interpretations on Interchange Rules 30, 60 and 101 are issued

The Arbitration Committee has issued the following interpretations of Rules 30 and 60 to eliminate taking of joint evidence on trivial deviations in stencil markings, which are retroactive to cover unsettled conditions.

Rule 30. Question:—It is common practice to stencil new light weight marks a few inches directly above or below the line of previous marks, to avoid delay in restenciling car account wet paint over old marks.

It is also the practice to substitute 3-in. stenciling for 4-in. stenciling where the letter is the standard for the car, as well as 4-in. stenciling where 3-in. stenciling is standard.

Do these deviations constitute wrong repairs?

Answer:—The new light-weight markings, as to location and size, should conform to the standard of the car; however, the conditions above described are not such to justify claim of wrong repairs.

Rule 60. Question:—Some roads are using 1¼-in. stencils, others 1½-in., for air brake marking, while the rule specifies 1-in. height. Should such marking be accepted?

Answer:—The question of increasing the size of air brake stenciling is under consideration. It is suggested that a minimum of 1-in. and a maximum of 1½-in. be accepted as meeting present requirements.

Rule 101. Effective January 1, 1926, upon recommendation from the Committee on Brakes and Brake Equipment, the Arbitration Committee has modified Item 22A of this rule to read as follows:

"Cylinder piston packing, Wabco, Flextite, Kendall or J. M. type...."

Attention is also directed to the following error in printing the 1925 Code of the Rules of Interchange, effective January 1, 1926:

Page 134, Rule 101, Item 194A, Note following—Service metal limit quoted in this note should read 35/16-in. instead of 3-5/16-in.

Standardization of chasers for self-opening die heads

Recommendations which will mean a reduction of 75 per cent in the sizes and varieties for chasers for self-opening die heads used in automatic screw cutting machinery were adopted by a general conference of manufacturers, distributors and users, held under the auspices of the Division of Simplified Practice, Department of Commerce, Washington.

This product, the manufactured value of which amounts to some $5,000,000 annually, is used to a considerable extent in the building and maintenance of cars and locomotives. The program adopted by the conference is estimated to hold a potential saving of $500,000 a year in manufacture and distribution, and a large indirect saving to every user of machine screws.

The simplification was in line with work done by the National Screw Thread Commission and the American Engineering Standards Committee, and is a step toward further standardizations in the field of mechanics, as well as helping to bring about a more general use of the accomplishments by the National Screw Thread Commission.

After discussions of the program by members of the Screw

Thread Commission, the American Railway Association, the American Electric Railway Association, the American Society of Mechanical Engineers, and others, the recommendations were adopted, to become effective April 1, 1926, and to be in effect for a year. A standing committee, comprising representatives of the manufacturers, the machine tool builders, mill supply dealers, and large consuming groups will be named to observe the application of the simplifications, to receive suggestions and to develop, if possible, further eliminations.

Meetings and Conventions

New York Railroad Club has unique program

The members of the New York Railroad Club were entertained at the monthly meeting on Friday, February 19, by the Baltimore & Ohio Glee Club. The program, which was given in the auditorium of the Engineering Societies Building, was received with great enthusiasm. The technical part of the meeting was somewhat unusual. A lively open forum discussion was held on constructive suggestions for improving the program and making the work of the club more effective. It was opened by the chairman of the Subjects Committee, Roy V. Wright, editor of the *Railway Mechanical Engineer.*

Chicago section A. S. M. E. to hold railway night

The regular monthly meeting of the American Society of Mechanical Engineers, Chicago Section, held Wednesday evening, February 24, at the rooms of the Western Society Engineers, Monadnock Block, Chicago, was devoted to Railway Night, the subject for discussion being the three-cylinder locomotive. "Construction and Economy" features were presented by J. G. Blunt, mechanical engineer, American Locomotive Company; "Operation" by W. A. Pownall, mechanical engineer, Wabash; and "Some Test Results" by E. L. Woodward, western editor of the *Railway Mechanical Engineer.*

Association for railway women organized in Chicago

The Railway Business Women's Association, Chicago, has been organized by women employed by railroads, steamship companies, affiliated committees and the Pullman Company, for the purpose of advancing social, business and intellectual development. Membership is open to all women employed in transportation service. The organization is divided into divisions according to the various railroads, steamship lines and committees, 13 divisions having been organized so far. The association is similar to one already established in the Twin Cities, composed of approximately 1,000 members.

Officers of the association are, president, Miss Cora Nelson, associated with the Western Trunk Line Committee; first vice-president, Miss Nancy C. McKinley, secretary to the freight traffic manager of the Chicago, Rock Island & Pacific; second vice-president, Miss L. J. Noelle, of the Western Trunk Line Committee; third vice-president, Miss D. Oden, who is in charge of women on the Chicago, Burlington & Quincy; recording secretary, Miss H. Smith, of the Central Freight Association; corresponding secretary, Miss I. Gates, Chicago & North Western; financial secretary, Miss L. Kennedy, New York Central; and treasurer, Mrs. W. G. Brown, Baltimore & Ohio.

Lehigh Valley Shop Crafts Association dinner

The Association of Maintenance of Equipment Employees and the Shop Crafts Athletic Association at the system shops of the Lehigh Valley at Sayre, Pa., held their first annual dinner in the Assembly Hall at the shops on Thursday, February 18. There were over 1,100 shop crafts employees and their ladies present. Music was furnished by the Sayre System Shop Band. Harry Farr, piecework inspector, officiated as toastmaster. Two of the younger men who attended the Younger Railroad Men's Conference at Pittsburgh last November, told of what it had meant to them and gave encouraging messages to the apprentices and younger men who attended the dinner. The young men who spoke were Leo Downs, machinist apprentice, and Donald Green, electrician apprentice. Alexander C. Birney, chairman of the blacksmiths, commented on the remarkable spirit of co-operation which existed between the shop crafts employees and the management on the Lehigh Valley. Roy V. Wright, editor of the *Railway Mechanical Engineer,* discussed some of the fundamental principles upon which co-operation and teamwork are based.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4 to 7 inclusive, Hotel Roosevelt, New Orleans, La.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting March 9. A paper on the oil-electric locomotive in railroad service by L. G. Coleman, manager, Locomotive Department, Ingersoll-Rand Company, New York. Illustrated by lantern slides.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting March 1. The following papers will be presented: Further discussion of A.R.A. Rules; Discussion of Supplement No. 1 to the A.R.A. Loading Rules; The recommended changes to be presented before the A.R.A. Association in connection with A.R.A. Rules.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

International Railway Fuel Association.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting March 9. A paper on the annual meeting election of officers and a moving picture on steel will be presented by George A. Richardson, publicity manager, Bethlehem Steel Company.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting, March 11, at Fairmont Hotel, San Francisco, Cal. Reception and banquet to R. H. Ashton, president, American Railway Association.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Texas.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

G. L. Hulben has been added to the sales force of the Chicago branch of the Ludlum Steel Company, Watervliet, N. Y.

Roy M. Chisson has been appointed manager of railway sales of the Otley Paint Manufacturing Company, Chicago, Ill.

Harry Loeb, of the Philadelphia sales office of the Lukens Steel Company, Coatesville, Pa., has been transferred to the New York office.

J. Howard Horn, sales manager of the National Lock Washer Company, has been elected general sales manager, with headquarters at Newark.

James H. Enochs, representative of the Harnischfeger Sales Corporation, Milwaukee, Wis., has been appointed manager of the new branch established at Indianapolis, Ind.

The Ohio Injector Company, Wadsworth, Ohio, has established a branch office at 30 National building, Cleveland, Ohio, and has appointed F. L. Dalzell district sales manager.

The Sidney B. Roby Company, 203 South avenue, Rochester, N. Y., will in future represent exclusively in Monroe county, N. Y., The Geometric Tool Company, New Haven, Conn.

Braeburn Alloy Steel Corporation announce the new location of their Pittsburgh district sales office at First National Bank building, Pittsburgh, Pa. L. M. Brown is district manager.

E. T. McCleary, assistant vice-president in charge of operation of the Youngstown Sheet & Tube Company, Youngstown, Ohio, has been promoted to vice-president in charge of operations.

A. R. Pinney has joined the sales force of the Bonney Forge & Tool Works, Allentown, Pa., manufacturers of chrome vanadium wrenches. He has been assigned territory including Pennsylvania, New Jersey and Maryland.

W. G. Willcoxson, formerly representative of Milar Clinch & Co., Chicago, has been appointed representative of the Boss Bolt and Nut Works division of the Hoopes & Townsend Corporation, with headquarters in Chicago.

Herman Steinkraus now represents the Bridgeport Brass Company, Bridgeport, Conn., in the Cleveland, Ohio, territory. Mr. Steinkraus has charge of the Bridgeport Brass Company's Cleveland warehouse service as well as sales.

Fred A. Fenton, who formerly represented Joseph T. Ryerson & Son, Inc., New York, covering railroads and industrials on machine tools, has opened an office at 30 Church street, room 423, New York City, as a representative of manufacturers.

P. E. Krider, district manager of S. F. Bowser & Co., Inc., Ft. Wayne, Ind., with headquarters at Chicago, has been promoted to manager of railway sales to succeed E. M. Harshbarger, who has been appointed district manager, with headquarters at New York.

The Erie Foundry Company, Erie, Pa., has opened the following district sales offices: At 1120 Myrtle avenue, Plainfield, N. J., in charge of H. Terhune; 549 Washington boulevard, Chicago, in charge of L. F. Carlton, and 408 Donovan building, Detroit, Mich., in charge of R. B. McDonald.

Bard Browne has been appointed assistant to the vice-president in charge of sales and service of The Superheater Company, 17 East Forty-second street, New York. Mr. Browne came with the company in 1914, and has been actively identified in the application of locomotive superheaters and feedwater heating devices, serving in various engineering sales and service capacities.

The Chicago Steel Car Company, Harvey, Ill., has changed its name to the Gibson Car & Manufacturing Company. R. A. Pascoe, secretary of the Whiting Corporation, has also been appointed secretary-treasurer of the Gibson Car & Manufacturing Company, and T. S. Hammond, president of the Whiting Corporation, has been appointed vice-president of the Gibson Car & Manufacturing Company.

The stockholders of the Pressed Steel Car Company have approved the plan for the merger into that company of the Western Steel Car & Foundry Company, all the stock of which was owned by the parent company. The stockholders also approved a change in the capital structure, calling for the establishment of cumulative preferred stock. F. N. Hoffstot, president of the Pressed Steel Car Company, stated that the Skelly interests had acquired a large holding in the Pressed Steel Car Company and that J. S. Skelly had been elected a director, succeeding George H. Russell, resigned.

The Virginia Equipment Company, makers of Virginia dust guards for the railroad industry, and the Michigan Head Lining Company, makers of cooperage products, which have for several years been operated as separate companies under the same ownership and management, have been consolidated into one corporation to be known as the Lacey Williams Company, with general office in the Hanna building, Cleveland, Ohio.

Godwin Shenton, formerly assistant to the president and manager of the Coplan Steel Corporation, Ogdensburg, N. Y., is now associated with The Q and C Company in the mechanical staff and will specialize and co-operate with the Ohio Steel Foundry Co., of Springfield and Lima, Ohio, in the manufacture and sale of locomotive grate bars made of special heat enduring steel. Mr. Shenton's headquarters will be at 90 West street, New York City.

LeGrand Parish has retired as president of the American Arch Company, New York, and has been succeeded by H. B. Slaybaugh, who has been executive vice-president of the company and has been associated with Mr. Parish throughout the life of the company. George A. Price, treasurer, has been made secretary and treasurer; F. B. Johnson has been made assistant secretary, and H. W. Muller has been made assistant treasurer, all with headquarters at New York.

M. A. Herald has resigned as sales representative of the Standard Tank Car Company, Sharon, Pa., and has organized The United Car & Equipment Company, with offices in the Westinghouse building, Pittsburgh, Pa. In addition to operating The United Tank Line, The United Car & Equipment Company will be the representative of the Union Draft Gear Company, the Universal Draft Gear Attachment Company and other manufacturers, dealing in new and second-hand railroad cars and equipment.

The Dreses Machine Tool Company, Cincinnati, Ohio, has given a contract for an entirely new plant to cost $100,000. The Austin Company, Cleveland, is the engineer and builder. The new plant will be of one-story design, 90 ft. by 300 ft, with monitor. About 100 tons of structural steel will be required. Cranes will be installed, two 5-ton cranes in the center aisle and one 3-ton crane in the side aisle. The Austin Company contract includes heating, lighting, plumbing and erection of cranes in addition to construction.

The Northwestern Motor Company, Eau Claire, Wis., has appointed the following representatives: W. Newton Jeffress, Inc., Washington, D. C.; Shaffner & Allen, New York; Otis B. Duncan, Chicago; A. A. Culp, Birmingham, Ala.; William J. Roehl, St. Louis, Mo.; Rank & Goodell, St. Paul, Minn.; the W. H. Worden Company, San Francisco, Cal; the Western Railway Supply Company, Portland, Ore., and the Koppel Industrial Car & Equipment Company, Koppel, Pa. W. Newton Jeffress, of the Washington office, has been appointed manager of sales for the Eastern region.

Plans for the reorganization of the North American Car Company, Chicago, as the North American Car Company of Illinois were approved at a stockholders' meeting on January 22. The new organization will have a capitalization of 125,000 shares of common stock, of which 83,500 will be issued. The purpose of the financing is to provide the company with additional capital to meet the needs of an expanding business. The plan calls for the exchange of the class A stock of the present corporation for the common stock of the new concern on a share-for-share basis, and of the present common stock on a two-for-one basis.

At a meeting of the board of directors of the J. G. Brill Company on January 29, W. H. Woodin, president of the American Car & Foundry Company, was elected a director to fill the unexpired term of William H. Heulings, Jr., deceased. At the

organization meeting of the Brill Corporation, a Delaware corporation, held in New York City, on January 30, the following directors were elected: Samuel M. Curwen, William M. Hager, Francis A. Lewis, William Clarke Mason, E. P. Rawle, C. S. Sale, G. R. Scanland and W. H. Woodin, and the directors elected the following officers: W. H. Woodin, chairman of the board; Samuel M. Curwen, president; G. R. Scanland, vice-president; H. C. Wick, secretary, and S. A. Mallette, treasurer.

The interests of the Columbia Steel Company, Elyria, Ohio, and the Forged Steel Wheel Company, Pittsburgh, Pa., have been combined. Sufficient finishing equipment to assure control over every operation entering into the production of hot and cold rolled strip steel will be installed. The Columbia Steel Company started operation in 1898 and for years manufactured high grade cold rolled strip steel. The manufacture of forged steel wheels, for railroad equipment, the principal product of the Forged Steel Wheel Company, will be continued at the Butler plant, and the manufacture and selling of this product will be handled by the same organization as in the past. The plant of the Forged Steel Wheel Company was first operated in 1912. The products consisted of forged wheels, billets, slabs, plates and bars.

The American Car & Foundry Company has formed the American Car & Foundry Motors Company, which was incorporated in Delaware, on December 23. The new company will own a controlling interest in the Fageol Motors Company of Ohio, manufacturers of motor buses and trucks, and in the Hall-Scott Motor Car Company of Oakland, Cal., manufacturer of gasoline engines for motor trucks, airplanes and motor boats and the new company in turn will be controlled by the American Car & Foundry Company. This is the first important entry by a railroad equipment company into the automotive field and the formation of this company is in line with the trend toward new forms of locomotion in the railroad field. The new company was organized to develop the business in gasoline railway equipment and will manufacture trucks for railroad companies.

The Coach & Car Equipment Corporation, Railway Exchange building, Chicago, has been organized to handle seating material and seating equipment for steam and electric railways and motor coaches by Edward Buker, formerly manager of railroad sales of the Heywood-Wakefield Company, with headquarters at Chicago. Mr. Buker graduated from the University of Illinois in 1908 and for the following three years was a car apprentice for the Pullman Company. For the following two years he was a special boiler maker apprentice on the Illinois Central and was later promoted to inspector, with headquarters at Chicago. In 1915 he was appointed general foreman on the Minnesota division of the Chicago, Rock Island & Pacific, and in 1916 was appointed master mechanic of the Missouri-Kansas-Texas, with headquarters at Dallas, Tex. In 1919 he entered the employ of the Galena Signal Oil Company as a mechanical expert and salesman and a year later was appointed western sales manager of the Rome Iron Works. In 1920 he became manager of railroad sales of the Heywood-Wakefield Company, with headquarters at Chicago.

E. Buker

Clinton L. Bardo, formerly general manager of the New York, New Haven & Hartford, who resigned in June, 1925, has been elected vice-president of American Brown, Boveri Electric Corporation, with headquarters at 165 Broadway, New York City, a subsidiary of Brown, Boveri & Co., Ltd., Baden, Switzerland, electrical manufacturers, who early this year announced that they would enter the American market. The new company has bought the plant of the New York Shipbuilding Corporation at Camden, N. J., and will make this its manufacturing center for the building of turbines, electric locomotives and large electrical apparatus. In addition, the company has manufacturing facilities at Hyde Park, Boston, Mass., and at Sidney, N. Y. Mr. Bardo, who will have his headquarters at New York, is on a tour abroad, inspecting the plants of the associated companies.

R. M. Thomas and Donald Charlton have been appointed technical representatives of the Reading Iron Company, Reading, Pa. The technical department, which they head, is a newly created service division in the sales department. R. M. Thomas for the past four years has been associated with the Chicago office of the Reading Iron Company. He received his technical training at Cornell University and Carnegie Institute of Technology, and is a member of the American Institute of Mining and Metallurgical Engineers and the Western Society of Engineers. Mr. Thomas will represent the Reading Iron Company in offices of various railroad systems of the West. His headquarters will be at 449 Conway building, Chicago, Ill. Donald Charlton has been for the past six years in the manufacturing division of the Reading Iron Company, the last two and one-half years of which he served in the capacity of assistant engineer of tests. Mr. Charlton will call on eastern railroads and will have his headquarters in the general office of the Reading Iron Company, Reading, Pa.

Henry M. Norris, secretary and a director of the Cincinnati Bickford Tool Company, died suddenly of heart disease on December 24, at Cincinnati, Ohio. Mr. Norris was born in Trenton, N. J., January 21, 1868. He received his earlier education in the Trenton schools and began his mechanical career as an apprentice in Bement, Niles & Company's shops. He entered the Sibley College of Cornell University as a special student in mechanical engineering and then went to the Ferracute Machine Company as draftsman. Later he was employed by the Brown & Sharpe Manufacturing Company and the Pond Machine Tool Company. From 1894 to 1895 he was superintendent and engineer for the Appleton Manufacturing Company and the Riehle Brothers Testing Machine Company. He was general manager of the Campbell & Zell Company. In 1897 he became works manager of the Bickford Drill & Tool Company, continuing in this capacity until the formation of the Cincinnati-Bickford Tool Company in 1909, when he became secretary and a director of the new organization. Mr. Norris was an inventor in the machine tool field, and his work was especially identified with the development of the modern type of high speed lathe and radial drill. He also wrote a number of treatises on machine tool subjects. In 1892 Mr. Norris joined the American Society of Mechanical Engineers. He was chairman of the Cincinnati section of the society in 1920 and a manager of the council of the society from 1920 to 1923.

Henry M. Norris

Following the co-ordination of the engineering, manufacturing and sales departments, as it relates specifically to the steam power equipment manufactured by the Westinghouse Electric & Manufacturing Company, at the South Philadelphia and Attica works, H. T. Herr, resident vice-president in charge of these activities, announces the following appointments: Howell Van Blarcom has been appointed manager of the sales department with R. E. Carothers as assistant manager. The large turbine sales section of the South Philadelphia works will be conducted with A. H. Ganshird as manager. This section will handle all matters pertaining to straight reaction and combination turbine and turbo-generator units for land and marine service. The small turbine section will be in charge of C. G. Ong, while P. L. Fetzer will be manager of the condenser section.

Personal Mention

General

G. W. GILLELAND has been appointed superintendent of motive power of the Central and Southern districts, with headquarters at Jacksonville, Fla., succeeding Mr. Hanlin.

R. B. WHITE, former general manager of the Baltimore & Ohio, New York Terminals, has been elected senior vice-president of the Central Railroad of New Jersey, with headquarters at New York.

J. J. HANLIN, superintendent of motive power of the Seaboard Air Line, has had his jurisdiction extended to include the Southern district, and has also been appointed superintendent of motive power of the Charlotte Harbor & Northern, with headquarters at Jacksonville, Fla.

The appointment of P. W. KIEFER as chief engineer of motive power and rolling stock of the New York Central was announced in the February *Railway Mechanical Engineer.* His jurisdiction includes all the New York Central Lines and not the New York Central Railroad only, as might have been inferred from the announcement.

EDWIN P. MOSES has been appointed engineer of rolling stock of the New York Central Lines, with headquarters at New York. He entered railway service on June 1, 1905, with the New York Central & Hudson River as a draftsman (locomotive and car), and on July 1, 1909, became leading car draftsman. He became chief car draftsman on February 15, 1911, and general car inspector on September 1, 1918. From March 16, 1921, to September 15, 1921, he was foreman construction inspector, and from the latter date to March 16, 1923, was general inspector. He became chief equipment inspector on March 16, 1923, assistant engineer of rolling stock on May 1, 1924, and general equipment inspector of rolling stock on January 1, 1925, which position he was holding at the time of his recent appointment.

F. H. HARDIN, who has been promoted to assistant to the president of the New York Central Lines, was born on June 14, 1886, at Gainesville, Ga., and was graduated from the Georgia School of Technology in 1908, and from Columbia University in 1909. He entered railway service on August 1, 1909, and until August, 1911, was a special apprentice on the New York Central & Hudson River (now a part of the New York Central), at West Albany, N. Y., and from August, 1911, to March, 1912, was construction inspector. At that time he became assistant enginehouse foreman, which position he held until October, 1913, when he became assistant general foreman at Utica. From November, 1914, until March, 1917, he was a special engineer in the office of the assistant to the president, and from that date until November, 1918, was master mechanic on the Adirondack division. He became assistant to the federal manager in November, 1918, and in March, 1920, chief engineer of motive power and rolling stock, which position he was holding at the time of his recent promotion to assistant to the president.

F. H. Hardin

A. A. RAYMOND has been appointed superintendent of fuel and locomotive performance of the New York Central, with headquarters at Utica, N. Y. He was born on November 11, 1886, at Troy, N. Y., and was graduated from Cornell University in 1910, with the degree of M. E. He entered railroad service on July 15, 1910, with the New York Central as a special apprentice at the Avis shops, and on November 16, 1912, was appointed assistant enginehouse foreman. On January 17, 1917, he became service test engineer at New York, N. Y., and on July 16, 1920, he was appointed assistant master mechanic, with headquarters at Syracuse, N. Y. Mr. Raymond served in the same capacity at Buffalo, N. Y., from November 1, 1922, until June 16, 1924, when he became master mechanic at Watertown, N. Y., which position he held until his recent appointment as superintendent of fuel and locomotive performance.

CHARLES E. BARBA has been appointed mechanical engineer of the Boston & Maine, with headquarters at North Station, Boston. Mr. Barba was born on May 12, 1877, in Freemansburg, Pa., and was graduated from Lehigh University in 1901. From July, 1901, to July, 1902, he was a draftsman in the Ordnance Department at Washington, D. C. He entered the service of the Pennsylvania in July, 1922, in the motive power department at Altoona, and until February, 1915, was consecutively draftsman, assistant chief draftsman and assistant engineer. He resigned in 1915 to join the Midvale Steel Company at Philadelphia. He was with this company from February, 1915, to November, 1917, first in the production office, then as foreman, and later as superintendent of a machine shop. He left this company in 1917, to take up war-time work at the Watertown Arsenal, and from 1917 to 1922 he served successively as superintendent of the mobile carriage shop and superintendent of the sea coast department of the arsenal. In 1922 Mr. Barba became superintendent of the Osgood-Bradley Car Company at Worcester, Mass., which position he was holding at the time of his appointment as mechanical engineer of the Boston & Maine.

Master Mechanics and Road Foremen

F. S. MARKETT has been appointed master mechanic of the Charlotte Harbor & Northern, with headquarters at Arcadia, Fla.

H. C. QUARLES has been appointed master mechanic of the West Florida division of the Seaboard Air Line with headquarters at St. Petersburg, Fla.

G. A. HASLETT has been appointed general road foreman of engines of the Central and of the Seaboard Air Line, with headquarters at Tampa, Fla.

L. E. CREVASSE has been appointed master mechanic of the East Florida division of the Seaboard Air Line, with headquarters at West Palm Beach, Fla.

E. R. HANNA has been appointed master mechanic of the Central Kansas division of the Missouri Pacific, with headquarters at Asawatomie, Kan., succeeding W. P. Kershner, resigned.

W. D. FREEMAN has been appointed master mechanic of the North Carolina division of the Seaboard Air Line, with headquarters at Hamlet, N. C., succeeding T. J. Raycroft, resigned.

M. R. BENSON has been appointed division master mechanic of the Michigan Central, with headquarters at St. Thomas, Ont., succeeding E. R. Webb, relieved at his own request on account of health.

THOMAS E. CANNON, general master mechanic of the Great Northern, with headquarters at Superior, Wis., has been appointed general superintendent of locomotives and equipment of the Pittsburgh & West Virginia, with headquarters at Pittsburgh, Pa. He was born on April 23, 1856, at New York, N. Y., and was educated in the public schools at New York. He entered railway service in 1871, with the St. Paul & Pacific, afterwards the St. Paul, Minneapolis & Manitoba, and now the Great Northern, and until October 3, 1875, was a machinist's apprentice. From October 3, 1875, to April 6, 1878, he was a fireman, and from the latter date until December 1895, was a locomotive engineman. At that time he became master mechanic, and later became general master mechanic, of the Lake district, which position he was holding at the time of his recent appointment as general superintendent of locomotives and equipment of the Pittsburgh & West Virginia.

Shop and Enginehouse

C. W. DAVIS has been appointed night enginehouse foreman of the Kansas City Southern at Shreveport, La.

O. E. WINGER has been appointed assistant enginehouse foreman of the Kansas City Southern at Shreveport, La.

E. W. Hess has been appointed general enginehouse foreman of the Kansas City Southern with headquarters at Heavener, La.

L. C. Kirkhuff has been appointed general locomotive foreman of the Kansas City Southern with headquarters at Shreveport, La.

E. M. Hercher, air brake machinist of the St. Louis Southwestern has been promoted to enginehouse foreman, with headquarters at Pine Bluff, Ark.

J. E. Potter, assistant enginehouse foreman of the St. Louis Southwestern with headquarters at Pine Bluff, Ark., has been promoted to enginehouse foreman succeeding O. E. Cole, resigned.

Purchasing and Stores

L. Frost has been appointed general storekeeper of the Missouri & North Arkansas, with headquarters at Harrison, Ark.

J. W. Moriaety has been appointed storekeeper of the Charlotte Harbor & Northern, with headquarters at Arcadia, Fla.

T. A. Rousseau has been appointed storekeeper of the Seaboard Air Line with headquarters at Howells, Ga., succeeding Mr. Hodges.

G. H. Wall has been appointed division storekeeper of the Chicago & Alton with headquarters at Slater, Mo., succeeding Mr. Murphy.

A. Hensler has been appointed assistant storekeeper of the Seaboard Air Line with headquarters at Jacksonville, Fla., succeeding Mr. Rousseau.

W. W. Morris, assistant purchasing agent of the Pennsylvania, has been promoted to assistant to the general purchasing agent, Philadelphia, Pa.

Frank J. McMahon, has been promoted to general storekeeper of the New York Central, lines west of Buffalo, with headquarters at Collinwood, Ohio.

T. A. Hodges has been appointed assistant general storekeeper of the Seaboard Air Line and has been temporarily assigned to special duties in connection with building of new lines in Florida.

E. L. Murphy, division storekeeper of the Chicago & Alton, with headquarters at Slater, Mo., has been promoted to traveling storekeeper, with headquarters at Bloomington, in place of Mr. Wolfe.

E. J. Lamneck, assistant to the purchasing agent of the Pennsylvania, has been promoted to stationary storekeeper, with headquarters at Pittsburgh, Pa., succeeding A. W. Able, who died recently.

H. O. Wolfe, traveling storekeeper of the Chicago & Alton, with headquarters at Bloomington, has been promoted to assistant general storekeeper, with the same headquarters, a newly created position.

J. H. Davis, storekeeper on the Minneapolis & St. Louis with headquarters at Marshalltown, Ia., has been appointed purchasing agent of the Minneapolis, Northfield & Southern, with headquarters at Minneapolis, Minn.

R. C. Harris, general storekeeper, of the Pennsylvania, with headquarters at Philadelphia, Pa., has been promoted to assistant stores manager, succeeding G. W. Snyder, who recently became assistant chief engineer in charge of maintenance.

E. C. Hoffman, assistant purchasing agent of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has been promoted to purchasing agent, with the same headquarters, and the position of assistant purchasing agent has been abolished.

Frank Riley, chief clerk to the general storekeeper of the Chicago & Alton, with headquarters at Bloomington, Ill., has been promoted to general storekeeper, with the same headquarters, succeeding G. A. Secor, who resigned to enter other business.

J. P. Murphy, general storekeeper of the New York Central, lines west of Buffalo, at Collinwood, Ohio, has been promoted to stores assistant to the manager of purchases and stores of the system, with headquarters at Cleveland, a newly created position.

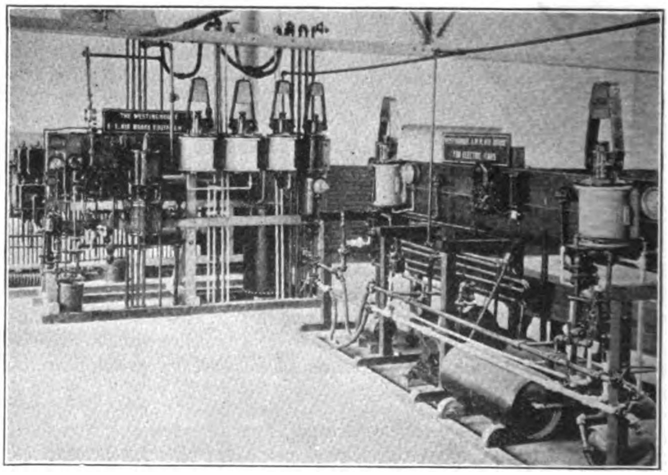
Obituary

C. W. Schaefer, blacksmith shop foreman on the Central of Georgia, Macon, Ga., died on January 29. Mr. Schaefer had been in the service of this road for about 35 years.

Robert Hobson, chairman of the board of the Canadian Locomotive Company, Ltd., Hamilton, Ontario, and president of the Steel Company of Canada, Ltd., died on February 25 at his home in Hamilton at the age of 65. He first began work on the railroads but later became secretary-treasurer of the Hamilton Blast Furnace Company. In 1899 he went to the Hamilton Iron & Steel Company as general manager, and in 1910, was appointed general manager of the Steel Company of Canada, Ltd., becoming president of that company in 1916. He had served also as an officer or a director of a number of financial and industrial organizations.

Wible L. Mapother, president of the Louisville & Nashville, died of heart disease at Panama on February 3. Mr. Mapother was born in Louisville, Ky., on September 28, 1872. Upon completing a grade school education he entered the employ of the Louisville & Nashville as an errand boy and file clerk in the office of the secretary. In August, 1889, less than a year after he had started to work, he attracted the attention of Mr. Smith, who was then vice-president and who at once transferred him to the clerical force in the executive department. In May, 1902, he was made chief clerk in the executive offices. His next promotion, on July 16, 1904, made him assistant to the president. On February 16, 1905, he was elected first vice-president. He was elected a director of the Louisville & Nashville on October 7, 1914. In November, 1915, he also became vice-president of the Lexington & Eastern, which was acquired by the Louisville & Nashville in 1912. During the period of federal control he was appointed federal manager of the Louisville & Nashville and the Louisville, Henderson & St. Louis. His jurisdiction was extended over the Nashville, Chattanooga & St. Louis, and the Tennessee Central, and later, over the Birmingham & Northwestern. On February 28, 1920, when the Louisville & Nashville system was turned back to private control, Mr. Mapother resumed his position as first vice-president and in March, 1921, succeeded Mr. Smith as president. Wible L. Mapother was in the service of the Louisville & Nashville for a continuous period of 38 years, all his business life having been spent with the company.

W. L. Mapother



Westinghouse air brake racks used for instruction in railway mechanical engineering at The Pennsylvania State College

Railway Mechanical Engineer

Volume 100 APRIL, 1926 No. 4

Table of Contents

NEXT MONTH

Concluding installment of the operation of the new Juniata locomotive repair shop of the Pennsylvania—Utilization of micrometers, dimension forms and semi-finished material

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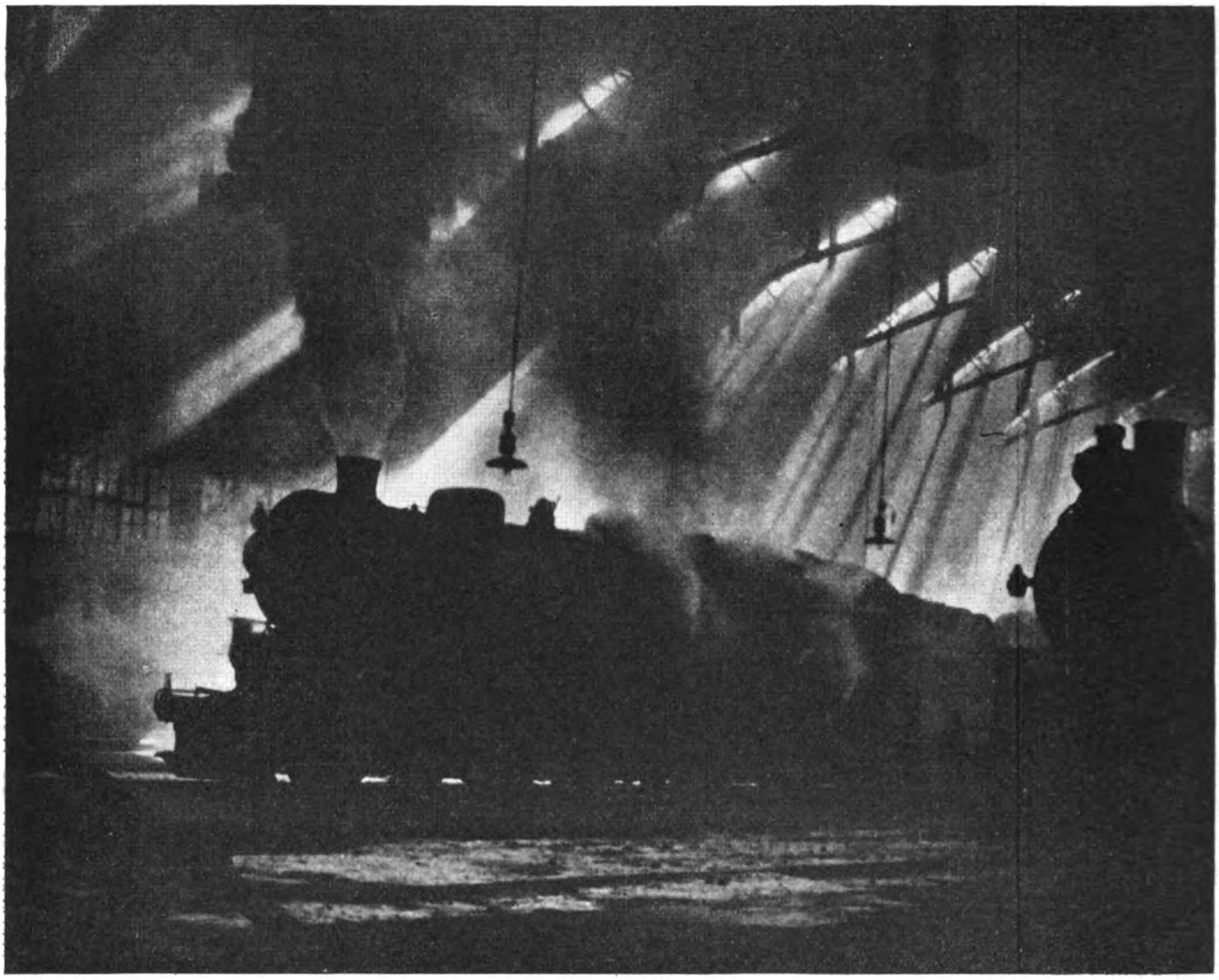

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Railway Mechanical Engineer

Vol. 100 April, 1926 No. 4

Checking up the foremen

The *Railway Mechanical Engineer* has had much to say on the matter of foremanship. For many months it has regularly published contributions received in the competition which was held last year on the foreman and his responsibilities and opportunities. It is doubtful if any contest which we have ever held has stirred up so much interest or had such a deep and widespread influence. In addition to the article in this number by Frank J. Borer, well known to readers of the *Railway Mechanical Engineer* because of his many contributions to our columns, will be found a letter referring to the "Bill Brown—Top Sergeant" controversy and sizing up the foreman from the viewpoint of a mechanic. We wish that we might have more communications of this sort, because, after all, the important thing is the impression that the foreman makes on the men who work under his direction. Undoubtedly railroad shop management practices would be revolutionized if every foreman clearly understood just what the men under him thought of him and how they viewed his actions. Few mechanics have the ability or hardihood to approach their superiors and talk with them frankly about such matters. We are delighted, however, to have one craftsman express himself in our columns, even though he has had to do it in an impersonal sort of way.

The apprentice training problem

We had quite a bit to say in the March number of the *Railway Mechanical Engineer* on the question of apprentice training. Readers of technical publications, unlike radio fans, do not greatly concern themselves with letting the editor know what they think of the publication and its policies. The few reactions that we have received to the editorial comment and articles in the March number have indicated approval of our position, but on the other hand, they are so few that they do not represent in any adequate way the opinion of our readers at large, nor do they reflect the attitude of more than a very few railroads. Following the article by C. Y. Thomas, supervisor of apprentices of the Kansas City Southern, in which he made a constructive suggestion looking toward the greater expansion of modern apprenticeship methods, we are presenting in this number another strong, constructive paper by F. E. Lyford, apprentice instructor of the Lehigh Valley at Sayre, on "The Moral Side of Apprentice Training." Mr. Lyford takes a keen personal interest in the apprentices at the system shops at Sayre. He feels strongly that there is something far greater in apprentice training than the mere education of the apprentice in manual skill and the theory and technique of the craft. The railroad needs employees of strong character and personality and the community needs better citizens. Is it not just as much a function of the apprentice department to help to develop character and citizenship as it is to turn out a skilled craftsman? What do you think of Mr. Lyford's suggestion?

Work reports should be carefully checked

Enginehouse efficiency is measured not only by the quality and cost of the work performed, but also and perhaps principally, by the speed with which the work is done. The back shop may take whatever time it needs to do its work in a systematic manner, but the enginehouse is required first of all to have locomotives ready when they are needed for the handling of trains. The necessity for speed quite often makes it impossible for the enginehouse forces to make a thorough examination of the locomotive as the work is being done to see if any repairs are required that have not been reported, and they have to depend largely on the information contained in the work report for the planning and performance of the work. Thus the work performed by the enginehouse forces is created by the engineman's work report, supplemented by the report of the outside inspector, which is made out as the locomotive goes over the inspection pit; from the standpoint of enginehouse efficiency, it is essential that these work reports show all the work that ought to be done on the locomotive before it is again placed in service.

It is customary on quite a number of railroads for the engineman and inspector to go over the locomotive together. While not always practicable, such a procedure does provide a check and quite frequently reveals defects that might otherwise be overlooked. The combined knowledge of the engineman and inspector, working together, should produce a sufficiently complete report by which the enginehouse forces can do a thorough repair job and it should only remain for the enginehouse foreman to see that the forces under his direction perform the work called for in the work report.

The importance of making intelligent work reports cannot be overstressed. It might be said that they control enginehouse production. Defects not reported are usually not corrected and quite often a minor defect which is overlooked will eventually cause an engine failure and require costly repairs.

It is customary on practically all railroads when a delay or engine failure occurs to make a check of the work reports. This, alone, however, is not sufficient to insure the right kind of work reports. Traveling engineers should check the enginemen's work reports to see that the information given to the enginehouse is complete. This work should be supplemented by frequent inspections by both the traveling engineer and master mechanic. They should call the engineman's attention to defects he did not report and drive home the fact that the work will not be

done unless it is reported. The enginehouse foreman should see that the work reported is properly performed and if the work is not done, the mechanic making the examination should be required to give the reason why he did not do the work. Insist on the enginemen making intelligent reports as they are in a better position to discover many defects while the locomotive is working than the enginehouse inspector. It is only by furnishing the enginehouse complete work reports that it can be expected to function properly in keeping down engine failures and running repair expenses.

Let's bring out the facts

The success with which locomotive shop scheduling has met in a great number of instances offers fairly convincing evidence that any railroad repair shop can hardly afford to be without some kind of a scheduling system. Fundamentally shop scheduling, or the routing of work, is nothing more nor less than some plan which will set a definite time in proper sequence for each operation to be performed so that there will be no lost motion in the job as a whole.

It seems to be characteristic for a railroad shop man either to assume a defensive attitude when the advisability of installing a "system" in his shop is suggested, or else to go to the opposite extreme and allow enthusiasm for a new idea to foster the installation of a system that requires more attention on the part of the supervisors to run the system than is required to run the shop. It is difficult to say which condition is worse—no system at all, or too much system; the company suffers in one instance, and the supervisors in the other.

During the past four years the *Railway Mechanical Engineer* has described several scheduling systems and many more have come to our attention which differ possibly in method of application, but are, in principle, based on similar ideas. One striking fact, however, has been that some relatively small shops have installed quite elaborate systems, while on the other hand, some large shops, turning out two and three times as many locomotives each month, are operating with remarkable results, with the work controlled by a system so simple that its installation added not a single man to the payroll nor a single burden to the supervisory force. Where, then, is the happy medium on scheduling systems?

Present day railroad operation demands the most intensive possible utilization of the facilities at hand. Traffic requirements, sometimes at least, also demand that motive power be held out of service for repairs as short a time as possible. Shop scheduling is merely one way of getting more out of existing shop facilities by taking the lost motion out of men and methods. More than this, an orderly method of performing any job makes that job easier and more interesting. The subject of shop scheduling is a wide one which has been the basis of thought if not of action on the part of almost every progressive locomotive shop superintendent or general foreman.

Locomotive shop operation differs so greatly from industrial plant operation that it is next to impossible for any one not directly connected with the work to contribute effectually to the installation of improved methods. Therefore it seems that the most valuable information which may be expected on this highly important subject must come from those who are faced each day with the solution of shop problems. Now seems to be the proper time for railroad shop men to give serious thought to this subject with the idea of bringing out a discussion of the subject at the meetings of the various associations which mechanical department men will attend during 1926.

The car man's opportunity

Training courses for car foremen, inspectors and workmen are not available in the curricula of any colleges or universities, and yet successful car department supervision is an art which can never be brought to the desired high standard unless the average car man backs up his long practical experience and observation by intensive outside study and the utilization of every available means of self improvement. He must not only seek a more intimate knowledge of the details of car inspection and maintenance work, but at least equally essential is a knowledge of how to direct the efforts and secure the loyal support of the men who work for him. Moreover, a broad point of view must be developed so that he may see beyond the confines of his own particular department and visualize how it should be operated in the best interests of the railroad as a whole.

Next to agriculture, railroading is the largest industry in this country, and the car department employs more men and spends more money for labor and material than any other single department of the railroad. Why is it that more car men do not succeed in reaching the higher executive positions? If there is one reason more than another, it is because they become too engrossed in the details of their own special work to see how best to co-ordinate their efforts with those of other departments—how best to develop the breadth of view which is absolutely essential in the successful railroad executive officer.

Car department supervisors have a splendid opportunity to improve their knowledge as car men or foremen (1) by active membership in car foremen's clubs; (2) by reading books on subjects related to their particular work and general railroad subjects; and (3) by studying railroad technical magazines such as the *Railway Mechanical Engineer* which make available to them each month the combined knowledge, training and experience of the best men "in the game." Intensive reading and study are essential, but no mere "bookworm" ever became a railroad president. Something more is essential, and for that reason the necessity of active participation in car foremen's clubs and other associations of railroad men should be particularly emphasized. After all, the ability to meet men, make a favorable impression, and stand up in public and express an idea clearly and concisely, is an invaluable asset to a man in almost any walk of life and railroad car foremen are no exception.

Car foremen's clubs are available in many of the important railroad centers in this country, and where not already organized can be readily developed by a nucleus of live and energetic car men, the privilege of membership being extended to all car men ambitious for personal improvement and the betterment of railroad service. Take the Car Foremen's Association of Chicago, for example. Drawn from the greatest railroad center in the world, the car men of the Chicago district meet once a month for nine months in each year; listen to papers prepared by experts on various phases of car work, and then hear and express opinions on all sides of the various questions brought up. At these meetings many of the men who have made possible the rapid improvement in car design, building, inspection and repair, get together and offer to the younger men in the industry information that no college or university can supply. For members of the association unable to attend meetings, the published Proceedings afford a permanent record of the subjects discussed, providing a valuable library on car inspection, interchange, and repair work.

The Chicago Car Foremen's Association is the largest of its kind in this country and it would be practically impossible to organize the average association on as ambi-

tious a basis, but the fact remains that the car men of the country have a real opportunity in the organization of local clubs, and possibly greater benefit may come from membership in the relatively smaller clubs. The resultant increased knowledge of car department matters and better understanding of how to deal with other men will greatly increase the value of the members to themselves and to the railroads they serve.

Better methods in car shop production

Considerable progress has been made during the past ten years towards obtaining more efficient methods in car shop production. But, in some respects car department is still behind the locomotive department. For example, one will usually find a more complete system of supervision of tools and facilities in the locomotive shop than in the car shop. Tool supervisors and shop drafting rooms are more often included in the locomotive shop organization than in the car shop organization. Yet it is generally recognized that the character of the tools, jigs and fixtures plays a large part in determining the output of the shop, and the utilization and the types selected are of primary importance. Why should not this fundamental factor in car shop production receive the same attention as it does in locomotive repair work?

It is not an uncommon occurrence to see two or three different types of scaffolding or a variety of trucks for handling car doors and steel ends in the same car shop building. A visit to several car repair shops on the same system will often show a wide variety of air operated devices for performing the same functions. Why have all this conglomeration of devices? Surely some must be better than the others. Better efficiency in car shop production could be obtained if more attention were paid by the mechanical department to the standardization of these jigs, fixtures and devices.

The car department might well assign some man who is an expert in car repair work, the task of seeing that all car repair points on the system are using the best possible jigs and fixtures. In many respects his work would be along the same line as that of the tool supervisor in the locomotive shops. He can eliminate tools using an undue amount of compressed air, and substitute other more economical means of doing the same work. His familiarity with all kinds of car repairs and the fact that his entire attention is devoted to the study of car shop tools and equipment, which is not the case with the car foreman, should make his services just as valuable as those of the tool supervisor in the locomotive shop.

If such a study can produce better production in locomotive repair work, it is certainly worth considering in the car department. In fact, a few railroads have had in operation some such system as the one proposed, for a number of years and have secured better production in car repair work.

Co-operation in fuel economy

The railroads have effected marked economy in the use of locomotive fuel in the past few months and, in fact, when expressed on a thousand gross ton-miles basis, including locomotive and tender, the fuel consumption in freight service was less during each month of 1925 than in the corresponding month of 1924, the average reduction being about 7 per cent, and 14 per cent as compared with 1923 figures. In passenger service also, the locomotive fuel consumption per passenger train car-mile in 1925 was approximately five per cent under that of 1924 and 12 per cent less than that in 1923.

This improvement was possible only by the co-operation of a large number of men in different branches of railroad service and among these are included many whose work is not ordinarily considered to have a direct bearing on fuel consumption. There is too great a tendency to consider enginemen and firemen responsible for unsatisfactory fuel consumption records, when possibly the best efforts of these men are being largely nullified by unnecessary train stops, train delays which could be avoided, fires knocked at terminals where locomotives could be run through, locomotives fired up and held under steam longer at terminals than necessary. Brakemen who are too tired to release brakes in yard service also have a direct influence on fuel consumption, in some cases causing engine slipping and in all cases undue wear on the equipment. It would be difficult to determine with exactness the coal wasted each time set hand brakes on cars being switched in yard service result in the slipping of locomotive drivers. In regard to this matter, however, W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore & Ohio, has the following interesting comment to make: "Assuming that on the average, three revolutions of the drivers will be made before the slipping is stopped, it is estimated that from 8 to 10 lb. of coal is wasted by the steam worked through the cylinders during each slipping period. In addition, the direct waste of coal by the tearing action on the fuel bed on the grates, making it necessary to level the fire, cover the holes or add coal to deepen the fuel bed, will probably amount to about the same quantity. Roughly, then, it may be said that on the average as much coal is wasted each time engines slip as is wasted by the pop valve being open for one minute, that is, from 16 to 20 lb. of coal."

Fuel economy is, and probably always will be, one of the most effective means of increasing railway operating efficiency. Definite performance marks should be set up as goals on the individual roads and an unremitting campaign carried on to stimulate interest and continue the good work now being done in the way of saving fuel.

New Books

AN INVESTIGATION OF THE FATIGUE OF METALS. *Bulletin No. 152 University of Illinois. By H. F. Moore and T. M. Jasper, Published by the Engineering Experiment Station, University of Illinois, Urbana, Illinois. Bound in paper, 6 in. by 9 in. 92 pages, illustrated. Price 50 cents.*

This bulletin is the report of an investigation conducted by the Engineering Experiment Station, University of Illinois, in co-operation with the National Research Council, the Engineering Foundation, the General Electric Company, the Allis-Chalmers Manufacturing Company, the Copper and Brass Research Association, and the Western Electric Company. The investigation was conducted by H. F. Moore, research professor of engineering materials, in charge of the investigation of fatigue of metals, and T. M. Jasper, research associate professor of the same department. It includes a description of the tests, apparatus, specimens used and results, together with a discussion of these results in relation to the general subject of the fatigue of metals. The tests include an investigation of the fatigue strength and static strength of steel at elevated temperatures, magnetic analysis as a test for fatigue strength of steel, fatigue strength of non-ferrous metals and case-carburized steel, and a discussion of the merits of the testing machines used for repeated stresses. The bulletin contains a number of charts, diagrams and illustrations of value to one who is interested in the fatigue of metals.

Wabash three-cylinder Mikado Type Locomotive

Three-cylinder locomotives discussed by Chicago engineers

Operating results on the Wabash—Analysis of effect of three-cylinder principle on capacity and economy

THE three-cylinder locomotive was the subject of discussion at the regular monthly meeting of the Chicago section of the American Society of Mechanical Engineers, held at Chicago, February 24. Papers were presented analyzing the effects of the three-cylinder principle on locomotive capacity and economy, on track stresses, and on the general wear and tear of the locomotive, and outlining the actual experience of two railroads with three-cylinder locomotives. In addition to the two papers abstracted below, a brief summary of tonnage tests conducted by the Union Pacific with a 4-10-2 type, three-cylinder locomotive was presented by E. L. Woodward, associate editor of the *Railway Mechanical Engineer*.

The paper by W. A. Pownall, mechanical engineer, Wabash, is of particular interest because of the considerable amount of information it contains bearing upon the question of three-cylinder locomotive maintenance.

Three-cylinder locomotive operation on Wabash

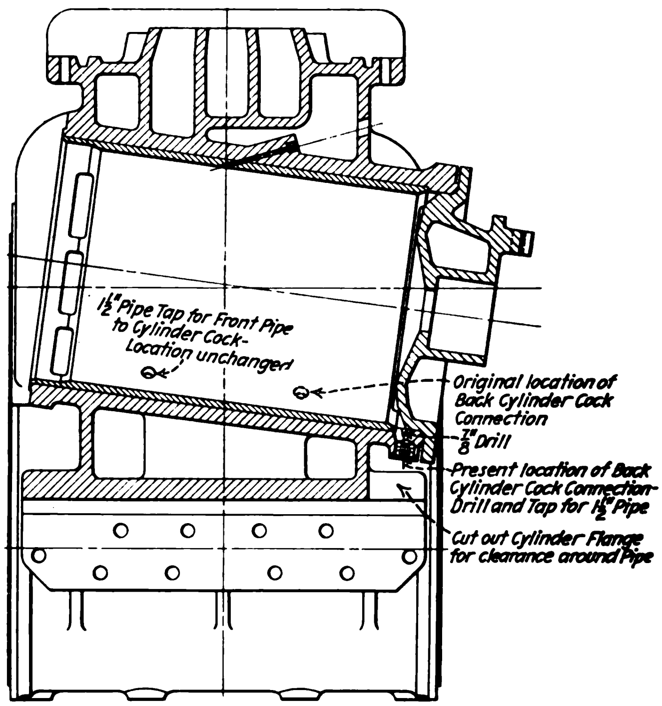
By W. A. Pownall
Mechanical engineer, Wabash, Decatur, Ill.

About a year ago 50 heavy Mikado type freight locomotives were built for the Wabash by the American Locomotive Company, Schenectady, N. Y. Before ordering these 50 engines considerable thought was given to the advantages claimed for the three-cylinder type. The performance of three-cylinder engines in service was investigated, and it was decided that while 45 of the 50 would be of the usual two-cylinder type the other five would be of the three-cylinder type.

The advantages which were expected from the three-cylinder engines as compared with the two-cylinder were briefly as follows:

Mechanical—Reduction of stresses on pistons, crossheads and rods due to dividing the load among three sets of parts instead of two. Less severe strains in main frames, axles and other parts of the locomotive because of more even distribution of the load or work transmitted from the cylinders through the axles, rods, wheels, etc. Less reciprocating weight to counterbalance, resulting in lessening the hammer blow on the rail as well as side thrust or "nosing" of the engine. Less damage to freight cars due to smoother starting of heavy trains.

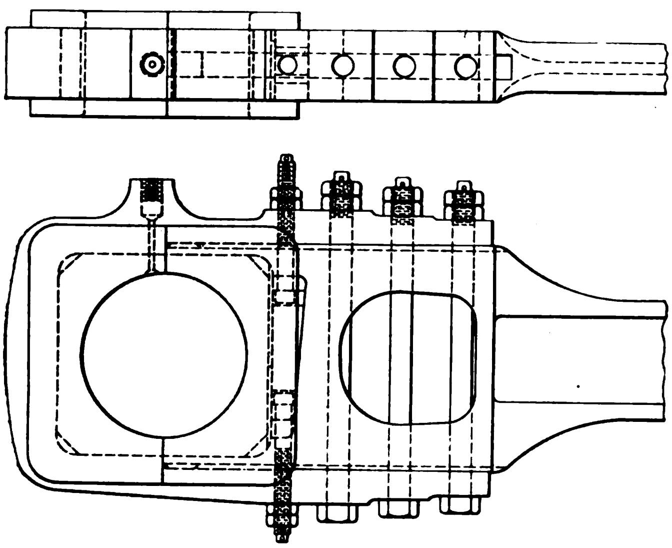
Operating—Increased tonnage per train or increased speed with the same tonnage, and a saving in fuel and water. Less slipping of the engine when starting heavy trains or with slippery rail conditions. Decreased track and bridge maintenance due to lower dynamic augment and nosing of engines.



Longitudinal section through the inside cylinder, showing the change in the rear cylinder cock location

Close adherence to heavy Mikado design

In preparing specifications for these engines the design of some Wabash heavy Mikados built in the previous year was closely followed, only such major changes being made as were necessary for the three-cylinder type for five of the lot. Arrangements were made for the other 45 to be readily convertible, if so desired at some future time, to three-cylinder engines with a minimum amount



Type of back end brass finally adopted for the inside cylinder on the Wabash

of change and expense. The principal change from the older, or class K-3 engines, consisted in increasing the distance between the second and third driver 13 in., the distance from the center of the cylinder to the engine truck wheel 4 in., and from the rear driver to the trailer 6 in., this last being due to an increase of 6 in. in firebox length rather than to any feature of the three-cylinder design. The 13-in. increase in distance between the second and third drivers was necessary in order not to have too short a middle main rod as well as to get proper angularity of this rod and clear the first and second axles. The engine truck was advanced 4 in. in order to provide necessary space in front for the valve gear for the center cylinder of the three-cylinder engine. The resultant increase in engine wheel base over the older engines was from 37 ft. 2 in. to 39 ft. 1 in., or 23 in. The main rod length was increased 10 in., and it was necessary to offset the center of the second driving axle in order to provide proper clearance for the center main rod.

These increases in wheel base cause little difference in appearance between the two and three-cylinder types. If at some time in the future the merits of the three-cylinder type justify conversion of the two-cylinder engines, it will be necessary to change only the cylinders, crossheads, valve gear, second and third driving axles and add necessary parts for the additional center cylinder.

These three designs of engine will be referred to as follows: class K-3 covers the two-cylinder type put in service early in 1924; class K-4 covers the 45, two-cylinder type, and class K-5 the five three-cylinder type, placed in service in 1925. The K-3 and K-4 have 27-in. by 32-in. cylinders while the K-5 has the two outer cylinders 23 in. by 32 in. and the center cylinder 23 in. by 28 in. in diameter and stroke.

The K-4 and K-5 carry 5 lb. more boiler pressure than the K-3, and the tractive forces developed are: K-3, 60,416 lb.; K-4, 61,965 lb.; K-5, 64,637 lb.

For comparison the following table shows the principal dimensions of these three classes:

Class	Two-cylinder type K-3	Two-cylinder type K-4	Three-cylinder type K-5
Cylinder diameter and stroke	27 in. by 32 in.	27 in. by 32 in.	2, 23 in. by 32 in. 1, 23 in. by 28 in.
Steam pressure	195 lb.	200 lb.	200 lb.
Diameter of drivers	64 in.	64 in.	64 in.
Tractive force, lb.	60,416	61,965	64,637
Factor of adhesion	3.94	4.01	3.87
Weights, lb.			
Drivers	238,000	248,450	251,215
Front truck	31,000	30,810	33,110
Trailer truck	56,000	54,470	56,165
Total engine	325,000	333,730	340,490
Tender loaded	196,500	194,500	194,500
Engine and tender	521,500	528,230	534,990
Cylinder horsepower	2,558	2,624	2,856
Heating surface, sq. ft.			
Firebox	273	309	309
Arch tube	32	32	32
Tubes	2,660	2,660	2,660
Flues	1,224	1,224	1,224
Total	4,189	4,225	4,225
Superheating	1,051	1,051	1,051
Grate area, sq. ft.	66.7	70.2	70.2
Mechanical stoker	Duplex	Duplex	Duplex

It will be noted that the K-5, with a slightly greater weight on drivers than the K-4, has an increase in tractive force of 2,672 lb., or 4.4 per cent, and a noticeably lower factor of adhesion. Thus, advantage has been taken of the feature of more even turning movement of the three-cylinder type of engine to use a lower factor of adhesion and obtain an increased tractive force or hauling capacity at slight increase in weight of engine and without having a "slippery" engine. The results in actual service will be touched on later.

The five three-cylinder engines were placed in service during April and May of 1925, and were assigned to fast merchandise freight trains running between St. Louis and Chicago. A good proportion of the distance is double

From	Cars	Tons	Miles	Time, hrs. and mins. Between terminals	Delay	In motion	Speed, m.p.h. In motion	Between terminals
St. Louis to Decatur..	50	2,019	108	3—50	— 6	3—44	28.9	28.2
Decatur to St. Louis..	75	2,430	108	4—53	—54	3—59	27.1	22.1
Decatur to St. Louis..	60	1,991	108	3—50	—27	3—23	31.9	28.2
Decatur to Chicago...	40	1,675	168	6—40	—55	5—45	29.2	25.2
Decatur to Chicago...	50	1,874	168	7—40	1—48	5—52	28.7	21.9
Decatur to Chicago...	52	2,046	168	6—32	1—25	5—07	32.8	25.7

track road, the ruling grade from St. Louis to Chicago is 0.6 per cent for the first 25 miles and 0.4 per cent for the balance of the way, and is 0.8 per cent, 0.7 per cent and 0.3 per cent from Chicago to St. Louis. Usually the heavy business is coal northbound, handled in 5,000-ton trains by 2-10-2 type engines, but the merchandise trains are necessarily of comparatively light tonnage in order to make the required speed, particularly to Chicago, where early morning deliveries must be made. Their average speed in motion is about 27 miles an hour. No attempt is being made to make long runs with these engines, and they are operated from East St. Louis, Ill., to Decatur, 108 miles, and from Decatur to Chicago, 168 miles. The northbound trains leave East St. Louis early in the evening and are due in Chicago, 276 miles away, at 4 o'clock the next morning. A few examples of these runs with the three-cylinder engines are shown here.

If the trains are late out of the terminal, or meet with unusual delays, they make considerably higher speed than shown in this table in order to get in on time. I rather hesitate to use the term "high speed" here, for undoubtedly some of the railroad men present have in mind right now some faster trains on their roads. However, most of the roads have some time freight trains that they watch particularly, and if the conditions are in any way similar to ours, the performance figures herein furnished may give a basis of comparison.

During 1924, these same time freight trains were handled partly by the class K-3 engines, which are, as already shown, very similar to the three-cylinder engines, and by our class L-1 engines, which are the 2-10-2 type

with 71,485 lb. tractive force. Fuel performance records are kept by individual engine and engineman, the amount of coal used being taken from engineman's coal tickets, and the train tonnage, etc., from the car accountant's records. Information taken from these fuel records and covering the performance of the three-cylinder engines from May to November, 1924, and for the two-cylinder engines for the same trains and corresponding months in 1925 shows the following comparison:

Class	L-1	K-3	K-5
Type	2-10-2	2-8-2	2-8-2
Cylinders	two	two	three
Total trips	368	677	1,078
Average tons per train	1,937	1,714	1,853
Lb. coal per 1,000 ton-miles	136.8	118.6	113.6
Per cent saving, three-cylinder.. Class K-5 over two-cylinder.. Class L-1	....	....	16.96 per cent
Per cent saving, three-cylinder.. Class K-5 over two-cylinder.. Class K-3	....	....	4.2 per cent

These records show that the three-cylinder class K-5 engine handled time freight trains averaging 8.1 per cent heavier than the trains handled by the class K-3 two-cylinder engine of similar proportions during the corresponding period of previous year, and at a coal consumption of 4.2 per cent less on the ton-mile basis. The average train for the three-cylinder class K-5 was 55 cars, as compared with 45 cars for the class K-3. As compared with the 2-10-2 type, the three-cylinder engine fuel performance was 16.96 per cent better. The less favorable fuel showing of the 2-10-2 engine was probably due in a measure to these engines being somewhat heavy for this particular class of service, which would result in an increased fuel rate on the ton-mile basis. However, the three-cylinder engines did the time freight work previously done by the two-cylinder 2-10-2 type and class K-3 engines, and at a fuel saving of 10.4 per cent over the combined performance of the two-cylinder engines. There would not be so much difference in point of cut-off between two and three-cylinder engines in fast freight service since with both types the cut-off is comparatively light, but with full tonnage trains the three-cylinder engine would work at materially less cut-off, resulting in a greater per cent of fuel saving than shown here for fast freight service.

The figure of 113.6 lb. of coal per 1,000 ton-miles may look rather high in the light of not infrequent instances of 60 to 80 lb. per 1,000 ton-miles in drag freight service, but it should be remembered that the high speed demanded in the time freight service and the fact that the average train is perhaps less than 50 per cent of the dead freight tonnage rating are against a favorable fuel performance. Our records given here are for similar service and show favorably for the three-cylinder engines.

Road men favor three-cylinder type

These engines have now been in continuous service for about nine months. The opinions of the road foremen of engines and fuel supervisors have been asked for from time to time and I quote a few:

"At high or low speed the three-cylinder engine gets the train going quicker and rides better than the two-cylinder engine."

"It is easier for a three-cylinder engine to start a train without taking slack, and therefore causes less damage to draft gears."

"Any train that can be started can be run at a more uniform rate of speed and handled better over the hills."

"There is a saving in fuel and water over the two-cylinder engine."

"Train can be handled at 33 to 35 per cent cut-off where a two-cylinder would have to be worked at or near 50 per cent cut-off to handle same train."

Although the three-cylinder engines have been used mostly in this fast freight service, tonnage ratings for drag freight have been established from dynamometer car tests. A comparison of the rates thus established for the two-cylinder and three-cylinder engine is given here:

From	To	Ruling grade, per cent	Adjusted rating, tons: Two-cylinder	Three-cylinder	Car factor	Per cent increase three-cyl. over two-cyl.
East St. Louis	Worden, Ill.	0.6	4,130	4,360	7	5.6
Forrest, Ill.	Chicago	0.4	4,990	5,210	11	4.4
Chicago	Brisbane, Ill.	0.9	3,260	3,585	5	10.0
Brisbane, Ill.	Decatur, Ill.	0.7	3,670	4,175	6	13.8
Mt. Olive, Ill.	East St. Louis	0.3	6,240	6,510	12	4.3

The three-cylinder engines have 4.4 per cent greater tractive force than the two-cylinder, and where the ruling grade was 0.4 per cent and the train was kept moving, the tonnage rating increase was the same as the increased tractive force, that is, 4.4 per cent. However, on the steeper grades, which on these districts are usually momentum grades, the three-cylinder engine seemed to keep the train moving at a better speed on the first part of the hill, and it was possible to establish ratings somewhat greater than the two-cylinder engine ratings than the difference in tractive force justified. For example, the rating from Chicago to Brisbane was increased 10 per cent and from Brisbane to Decatur 13.8 per cent.

The three-cylinder engine admittedly possesses advantages from the mechanical and operating standpoint, but a serious question in many minds was whether the additional maintenance or increase in mechanical failures due to the extra parts and unusual features of design would not more than offset these other advantages. Past experience with engines having relatively inaccessible parts has been unfavorable in that these parts did not receive proper attention, resulting in road failures and ultimately rather heavy maintenance costs.

Although our five engines of this type have only been in service about nine months, and have not yet been in the shop for classified repairs, there has thus far been, with the exception of some middle main rod trouble, no more running repair work than on similar size engines of the two-cylinder type. The following table shows the mileage these engines have made each month in freight service, and these mileages are good evidence that the engines have not been spending much time in enginehouses undergoing repairs.

Twelve of the two-cylinder engines (class K-4) averaged 4,164 miles per month on an adjacent division.

Monthly mileage of three-cylinder locomotives on the Wabash

Month	No. 2600	No. 2601	No. 2602	No. 2603	No. 2604
May	5,572	3,598	5,205	3,260	....
June	4,504	2,978	5,166	4,552	4,578
July	4,968	4,641	4,398	4,384	5,160
August	5,664	4,644	4,992	4,532	2,668
September	4,464	4,798	4,764	4,769	2,182
October	6,264	5,028	4,522	4,854	3,552
November	5,616	3,840	4,376	4,684	4,800
December	5,002	4,850	3,360	4,560	4,530
Total	41,054	34,377	36,983	35,686	27,470
Average per month	5,132	4,297	4,623	4,461	3,924

Average per month per engine, 4,492 miles.

The matter of suitable middle main rod design, particularly the back end, has given the builders some concern. After our engines had been in service about six weeks we had some reports that the back end of the middle main rod was pounding. We had had more or less success with the use of the floating bushing for the middle connection of side rods and had decided to use this type of bushing for the back end of the middle main rod for the three-cylinder engines. The bushing was applied in three sections, the back end of the main rod being necessarily of strap construction since the solid back end main rod could not be applied to the crank axle.

The sections of the brasses first applied were $\frac{1}{16}$ in. between the ends, or a total of $\frac{3}{16}$ in. for the three openings, and the brasses were also applied so as to allow $\frac{1}{8}$ in. side play. The result of this side play and the

openings between the ends of the brass was more or less side slap and noise, which contributed to the complaints about rods pounding. The straps were attached to the rod with three bolts, and we had a little trouble on account of these bolts shearing, and had one actual engine failure due to a broken strap. However, this failed strap was traced to a defect in material. In view of this experience, we were not entirely satisfied with the floating bushing application, and it was decided to apply sectional brasses similar to the usual sectional brass used on the outside main rods. Two of the five engines were thus equipped. The other three engines continued to use the floating bushings, but with only 1/32 in. of lateral play and with the ends of the sections 1/32 in. apart instead of 1/16 in., giving a total end clearance of 3/32 in. instead of 3/16 in.

Water in third cylinder caused trouble

In the meantime we noticed more or less trouble with leaking of the center cylinder piston rod packing, and investigation indicated that this was due to water in the cylinder. There were two cylinder cocks for the center cylinder, and with this installation it was found that water not only accumulated in the passage leading to the cylinder, but could also accumulate in the back end of the inclined center cylinder. The cylinder cock location was changed to take care of this accumulation of water. The front cylinder cock was left in its original position. The back cylinder cock hole was plugged and the cylinder cock relocated so as to take the water from the lowest point of the center cylinder. The cylinder cocks are air operated so as to do away with the objection of long cylinder cock rigging from cab to cylinder.

Since making the change in cylinder cocks we have had little or no trouble with any of the main rods or with piston rod packing leaking, whether the engines are equipped with the sectional brass or with the original floating bushings. However, our records show that thus far the floating bushings have been renewed at an average mileage of 9,600, and frequently it has been advisable to renew the back end rod bolts at about the same interval. The two engines with the sectional brasses have had the brasses reduced on an average, once every 15,000 miles, the reduction each time being only 5/64 in. In view of the fact that floating bushings have to be renewed four or five times between shoppings, whereas the sectional brass may last from shopping to shopping with two or three "reductions," the expense of middle main rod brasses is considerably in favor of the sectional brass. This should not be construed as being against the floating bushings for outside rods, but is simply giving the results of our experience with different types of back end main rod brasses for center cylinder of our three-cylinder locomotives. We are inclined to favor the sectional brass rather than the floating bushing, but believe that what trouble we had with the main rod was probably due to water rather than to any improper or impractical design of main rod parts.

Summing up our experience with five locomotives of the three-cylinder type, I would say that:

1—Maintenance will not differ materially from the two-cylinder type. It will possibly be less over a longer period of time.

2—From the standpoint of train operation the three-cylinder engines will do better than the two-cylinder type.

3—The three-cylinder engine will make a moderate saving in fuel and water in fast freight service. probably more in drag freight service.

4—Enginemen and supervisory forces are, in general, well satisfied with the three-cylinder locomotives.

Effect of three cylinders on locomotive capacity

By J. G. Blunt

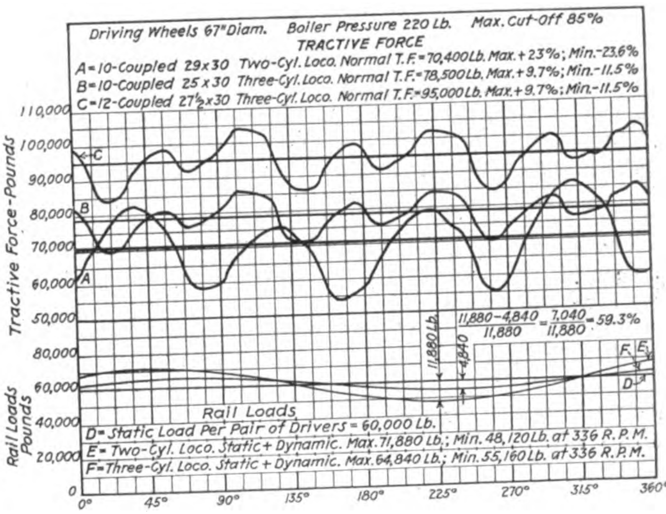
Mechanical engineer, American Locomotive Company, Schenectady, N. Y.

There are many explanations why the power is increased in the three-cylinder locomotive. The six cylinder-impulses per revolution of the driving wheels, by giving a more even turning moment, raise the low point of the tractive force curve, thus increasing the starting force and likewise, by lowering the high point, reduce the slipping tendency. This enables us to reduce the coefficient of adhesion. From 10 per cent to 15 per cent may thus be gained in normal tractive force, with from 20 per cent to 30 per cent increase in starting effort, thus giving a large tonnage capacity increase, with more rapid acceleration. One prominent road now using three-cylinder locomotives has continuously obtained a full 20 per cent normal tractive force increase, which means 40 per cent greater starting effort. We are thus enabled largely to increase the capacity of the locomotive and keep within specified weight limitations.

A two-cylinder locomotive is practically limited to five-coupled axles on account of the excessive counterbalance weight requirements, while the three-cylinder locomotive, with its lighter reciprocating weights and the ability to couple the outside cylinders to other than the crank axle, enables us, with much better balancing conditions, to use six coupled axles, thus adding another 22 per cent to the normal tractive force of the largest practical locomotive. We therefore can add, as the very lowest estimate, a total of 32 per cent to the normal tractive force, likewise increasing the starting force by at least 64 per cent. Tests have demonstrated the great power flexibility in the three-cylinder locomotive with slight changes in valve setting to meet the varying demands of starting effort, sustained power, speed and economy of fuel.

Dynamic effects on track 60 per cent less

With the more perfect counterbalancing, the dynamic effects on the track are calculated for the three-cylinder



A comparison of the tractive force and dynamic rail loads of two-cylinder and three-cylinder locomotives

locomotive as a whole to be approximately 60 per cent less than in an equivalent two-cylinder locomotive. Therefore, a 10 per cent increase in static load per driving axle would seem reasonable, as the dynamic effects would,

with such increase, still impose lower stresses on the track and bridges.

This would make possible a normal tractive force increase at least 35 per cent greater than in the largest possible two-cylinder locomotive, while having a starting power at least 70 per cent greater. I am informed by some users of the larger three-cylinder locomotives that this is far too conservative a claim, greater power percentages being more easily obtained in the larger units than with those of medium size.

As an example, assume a two-cylinder locomotive having cylinders 29 in. diameter by 30 in. stroke, 67 in. diameter drivers, 220 lb. steam pressure, five coupled axles, having a normal tractive force of 70,400 lb., with a minimum starting force of 56,320 lb. This same locomotive, if built as a three-cylinder locomotive, with cylinders 25 in. diameter by 30 in. stroke, 67 in. wheel and 220 lb. steam pressure, would have a normal tractive force of 78,500 lb., with a minimum starting force of 70,650 lb. and approximately the same slipping tendency. Add to this three-cylinder locomotive a sixth pair of coupled driving wheels, making it possible to use three 27½-in. diameter by 30 in. stroke cylinders, with 67 in. drivers, 220 lb. steam pressure, and we have a normal tractive force of 95,000 lb., or a minimum starting force of 85,500 lb. These comparisons are made on the basis of only 10 per cent normal tractive force increase in the three-cylinder locomotive over its equivalent two-cylinder locomotive. With a 20 per cent increase, the normal tractive force would be 103,600 lb.

Another striking comparison shows this two-cylinder locomotive in working order to weigh approximately 5.75 lb. per pound of tractive force developed, while in the six-coupled locomotive it would weight about 5.14 lb. per pound of tractive force developed, or 109 lb. per horsepower.

The representative of a leading English railway using many three-cylinder locomotives claims to obtain 16 per cent greater normal tractive force than in equivalent two-cylinder locomotives, with no more tendency to slip and with no more weight on the coupled wheels, while the minimum starting force is 30 per cent greater. These statements apply to comparatively small locomotives where, apparently, no attempt has been made to construct the most powerful unit.

Greater speeds possible

A three-cylinder locomotive is capable of more speed than a two-cylinder locomotive, due primarily to more perfect counterbalancing following the use of lighter reciprocating parts, which is very clearly exemplified in the test of a Missouri Pacific three-cylinder 2-8-2 type locomotive built by the American Locomotive Company, a report of which appears in the *Railway Mechanical Engineer* of July, 1925, the test having been conducted on the Altoona testing plant of the Pennsylvania.

Another most important influence on speed is the ability of the locomotive to negotiate curves, which is largely influenced by the degree and efficiency of the lateral resistance offered by the engine truck, trailer truck and other lateral motion or resistance devices. Generally speaking, the curving ability of a locomotive at higher speeds is best effected by means which gradually increase the resistance of each pair of truck or driving wheels leading up to or near the center of rotation of the locomotive mass in order to deliver the least severe shocks to the frame structure of the locomotive, tire flanges, rails or right-of-way. Locomotives capable of making the highest speed with safety should, furthermore, be suspended in such a manner as to maintain the maximum lateral stability against rolling.

It is well to remember, by way of comparison, that the boiler efficiency is much lower in a two-cylinder compound locomotive than with a corresponding two-cylinder simple engine, due to only one-half the number of exhaust impulses acting on the fire, although in the case of the compound locomotive the steam consumption may be much less. This shows one phase in the relative effects on fuel economy with the six exhausts per revolution of driving wheel in a three-cylinder as compared with the four exhausts in the two-cylinder locomotive. The exhaust tip may be relatively larger in a three-cylinder locomotive, thereby causing less back pressure. The marked increase in starting force of the three-cylinder locomotive enables the engine to operate a greater percentage of its running time in shorter cut-off and, therefore, more economically than the two-cylinder locomotive.

Union Pacific tests show 16.2 per cent fuel saving

In a comparative test conducted by the Union Pacific, as between a two-cylinder Santa Fe type engine with 74,941 lb. normal tractive force, and a three-cylinder 4-10-2 type locomotive with 78,000 lb., by equating the slight tractive force difference, the three-cylinder locomotive showed 20 per cent increase in power and used 16.2 per cent less coal per thousand gross ton miles hauled.

Few reports are available showing the comparative mileage between general repairs of three-cylinder locomotives and two-cylinder locomotives of about the same class and in similar service, but it is evidently much increased in the three-cylinder locomotive due to the better counterbalance and more even distribution of power to the frame structure by having one-third of the cylinder power between the frames and ability on some types to attach the outside cylinders to other than the crank axle. Records from English roads show from 7 per cent to 25 per cent increase in favor of the three-cylinder locomotive.

In 1923 the United States Department of the Interior showed that public utility power plants in the United States generated 36,092,000,000 kw. hours from plants using coal, oil or gas equal to 43,522,000 tons of coal. This is equivalent to 1.8 lb. of coal per indicated horsepower per hour, although a few of the very latest use but 1.2 to 1.4 lb.

It has been carefully computed that the best modern two-cylinder steam locomotives will develop a drawbar horsepower per hour on an average of between 2.55 and 2.77 lb. of coal exclusive of auxiliaries, and at the rate of from 2.81 to 3.11 including auxiliaries. An indicated horsepower hour may likewise be developed for between 2.35 and 2.57 lb. exclusive of auxiliaries, or from 2.61 to 2.91 lb. including auxiliaries.

Only 2.20 to 2.60 lb. of coal required per hp.-hr.

The three-cylinder locomotive will use from 2.20 to 2.60 lb. of coal per drawbar horsepower per hour exclusive of auxiliaries, or from 2.50 to 2.90 lb. including auxiliaries. An indicated horsepower will be developed from 2 to 2.4 exclusive of auxiliaries and from 2.20 to 2.60 including auxiliaries.

Experience has demonstrated that the three-cylinder locomotive reduces track stresses and maintenance. A careful check will, without doubt, show reduced tire wear for the three-cylinder locomotive, as it has done in foreign countries. Assuming this as a fact, this should correspondingly increase the life of the rail, showing large indirect economies that would follow its more general use.

No sincere advocate of the three-cylinder principle will claim perfection for it more than in other types of loco-

motives but careful analyses, reinforced by actual test, unmistakably indicate that the advantages to be gained far outweigh the disadvantages and afford an opportunity for effecting large economies in operating a railroad when the most powerful individual units are a factor.

Compounding in connection with the three-cylinder application offers possibilities from the standpoint of steam economy, the necessity for which will be more pronounced as boiler pressures are increased, but if generally adopted must be accomplished without appreciably affecting the maintenance problem or causing a marked recession in the power or speed features.

The many devices now on the market for effecting fuel economy and increasing tractive force have done about all that can be expected to increase the capacity of the two-cylinder locomotive and where still greater and more economical steam power units are required, the inevitable step is to adopt the three-cylinder principle with the determination to make use of the many advantages its design offers.

Comparative tests of cast iron brake shoes

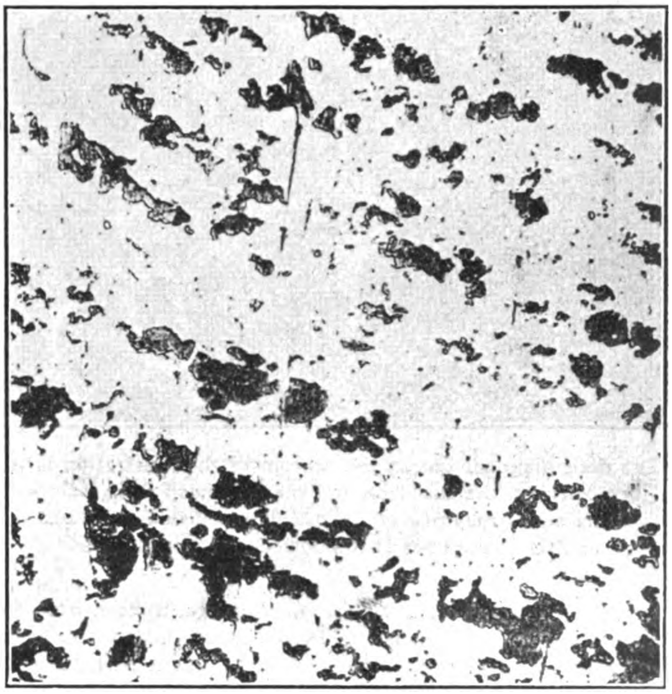
Shoes having an expanded metal insert are found to give more economical service

By Fred H. Williams

Assistant test engineer, Canadian National Railways, Montreal, Que.

A NUMBER of extensive tests made by several large railroads in the United States and Canada, show that a cast iron shoe with a steel back and expanded metal insert give a much better wearing shoe and equally good, if not better, frictional value and in the long run a more economical brake shoe than either the plain cast iron shoe or the partially chilled shoe. The first cost of this shoe with the expanded metal insert is more than the ordinary plain or chilled cast shoe having a steel back. Shoes without the steel back are not permitted under the rules of interchange of the A. R. A. The economy of the expanded metal insert in the brake shoe has been clearly demonstrated by both service and laboratory tests. The expanded metal insert increases the wearing quality so much that a shoe with the insert will outwear two or three plain cast iron shoes. Furthermore, breaks are more likely to occur when the supporting reinforcement is missing.

Photomicrograph of an expanded metal insert shoe, showing the cast iron at the top (dark) with the line where the cast iron meets the expanded metal with the metal of the insert below



The structure of the steel insert before the heat and carbon of the molten iron has changed its original structure

There are several governing features that limit the use of the brake shoe and effect its design. But it is not the intention of the writer to discuss the design of the shoe, which is recommended by the American Railway Association. It is quite evident that the design of the present

brake shoe is the result of much study, both theoretical and practical, and the standard shoe is quite within the limits of perfection as far as size and other details go. It is, however, the intention of the writer to consider carefully those features that are embodied in the material used in the brake shoe in so far as it relates to plain cast iron, chilled cast iron and shoes having the expanded metal insert. No consideration is given to other types of shoes, which may have more or less merit but have not as yet come under the observation of the writer.

The governing features of a good brake shoe are safety, first cost, wearing qualities, frictional value, maintenance cost, service and efficiency. But before considering these it would be well to give a brief description of the three principal types of brake shoes and also to mention that a detailed study of the structure of the shoe containing the expanded metal insert has been made with the microscope and photo-micrographs, some of which are illustrated in this article, which shows the essential features of structures. There are also shown photo-micrographs of the plain cast brake shoe structure in some of the illustrations.

The plain cast iron brake shoe has a pressed steel back, brake shoes not having a steel back not being considered in this article. The shoe is made in accordance with standard A. R. A. design and is not chilled on the wearing surfaces. The mould is made in the regular way, with

The dark diagonal line at the bottom of the illustration is the line between the cast iron and the expanded steel insert— The white network at the top is the free ferrite and and the white lines at the bottom the free cementite

the pressed steel back laid in place in the mould, and the moulten metal poured in. The shoes are taken out when cool, the fins and risers broken, cut or burned off and the shoes inspected.

The metal or mild steel back is made in various shapes, designed to prevent fractures or possible destruction of the shoe and to hold a steel lug used to fasten the shoe by means of a key to the brake head. These steel backs are punched and are generally formed from flat steel bars.

The cast iron in this type of shoe is a close grained gray iron having no white or chilled iron structure, except, possibly, around the steel back. This, however, is not of primary importance, unless it is excessive enough to cause cracks and a broken shoe.

The microscope structure of this shoe is mainly lamellar pearlite with an excess of cementite. Free graphite is found in thin flakes throughout the whole and there is no free ferrite. The Brinell hardness is from 200 to 300. Owing to the surface hardness of the shoe caused by the chilling of the shoe in the sand, the wearing quality of the shoe is better at the start of its life than it is when the shoe is worn a little. Thus a brake shoe of this type wears well when new but wears down more rapidly after being in service a short length of time. These plain cast

The transition from the cast iron at the upper right corner to the original structure of the steel of the insert at the lower left corner

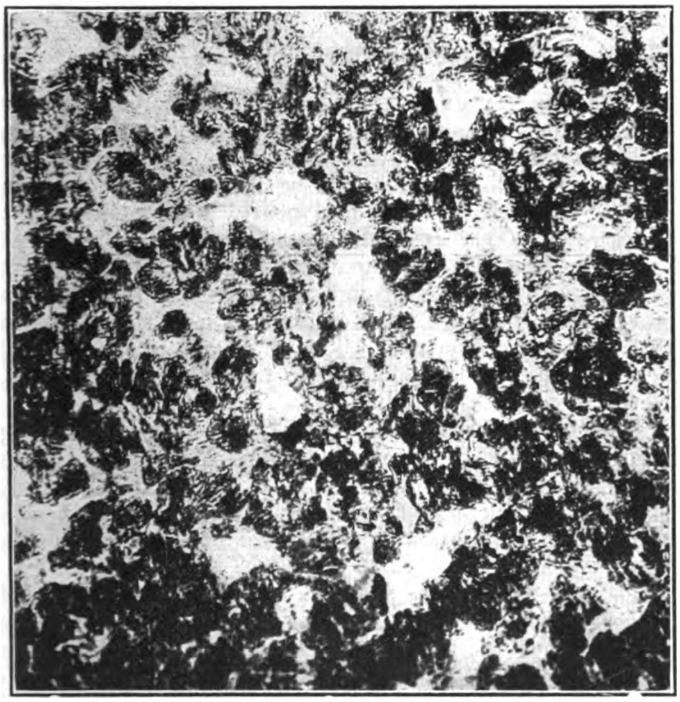
iron brake shoes are mostly used on freight cars except in the case of some roads which use a few on their passenger cars. The latter practice is not considered economical service.

The chilled cast iron brake shoe also has the pressed steel back and steel lug. It is made of similar cast iron except that the iron has qualities for a deeper chill. The difference in the manufacture of the two shoes is that chill blocks are placed in the mould of the chilled cast shoe so that the hot metal coming in contact with these metal surfaces is chilled on the ends of the brake shoe and from one to two inches of the wearing surface at each end. The rest of the surface is gray iron. This gives a shoe of proper frictional value and a good wearing face, having a wearing surface of about one-third white cast iron and two-thirds gray cast iron. This will vary somewhat depending upon the manufacturer.

The ratio of these two kinds of iron depends upon what the manufacturer considers will meet the requirements of the specifications to which the shoes are made. Care is taken to make these shoes of iron with a proper chemical content to give a good depth of chill and with this purpose in view, test bars are made from the iron coming from the cupola to ascertain the depth of the chill. This is accomplished by pouring the hot metal in a mould having chill blocks at the bottom. The bars are then broken

and the quality of chill noted. These chilled cast iron brake shoes are used on passenger and freight cars.

Cast iron brake shoes having an expanded metal insert are made with a pressed steel back similar to that previously described. These shoes differ because of the expanded metal insert which consists of a number of layers of expanded metal depending on the thickness of the shoe. They are tied together and dipped into a heat resisting mixture which protects the expanded metal. This bundle of expanded metal is then placed loosely in the mould and the hot metal is poured in, partially sur-



This photomicrograph shows the structure of the cast iron in the shoe with the expanded metal—Note the white iron which does not wear as rapidly as the softer irons and yet is softer than the cast iron wheel which is chilled

rounding the pressed steel back and all of the expanded metal insert.

The expanded metal in the mould partially chills the molten metal as it comes in contact with it, leaving a cast

Comparative table showing the cost and wearing qualities of cast iron brake shoes

	Plain cast iron	Chilled cast iron	Expanded metal insert
Wear in lb. per 1,000 wheel miles	1.73 lb.	1.11 lb.	.72 lb.
Equivalent to per cent	100	64.2	41.5
Shoes used	100,000	64,200	41,500
Cost of shoes per ton	$52.00	$57.00	$67.00
Weight, tons	1125	722	467
Scrap, tons	500	321	208
Cost of new shoes	$58,500	$41,154	$31,289
Less scrap value @ $10.00	$5,000	$3,210	$2,080
Net cost of shoes	$53,500	$37,944	$29,209
Cost of application 25c. each	25,000	16,050	10,375
Total	$78,500	$53,994	$39,584

Summary

Saving per equivalent 100,000 plain cast iron shoes by the use of expanded metal insert in shoes	$38,916
Saving per equivalent 100,000 plain cast iron shoes by the use of chilled cast iron shoes	24,506
Saving per equivalent 100,000 plain cast iron shoes by the use of expanded metal insert over chilled cast iron shoes	14,410

iron of mottled structure. The expanded metal is slightly changed on one side and somewhat more on the side that first comes in contact with the molten metal. It is coated so as to protect it from being burned by the molten iron. The internal portion of the expanded metal does not change but retains the lines of rolling that were in the sheet before being expanded.

The foregoing briefly describes the three types of brake shoes. The steel backs cary in shape in each type only in details of design considered by each manufacturer to be necessary to improve the shoe. The main feature of the expanded metal insert is that it produces a mottled iron in the shoe and by its softness is supposed to retain particles of the cast iron as they are torn away and thus increase the life of the shoe. Both these features lengthen the life of the shoe without its being of excessive hardness.

The structures described are illustrated in the photomicrographs. A cross section of the shoe with the expanded metal insert shows the insert as a network of reinforcing steel, well surrounded with the mottled cast iron and free from excessive blowholes or spaces surrounding the expanded metal.

The service tests that have been made by several railroads in both the United States and Canada are too extensive to describe in full, but it is interesting to consider the relative values of these shoes, considering the first cost, wearing qualities, maintenance cost, and service cost,

This view shows the structure of the ordinary cast iron brake shoe not chilled

combining and finally showing the benefit of using the expanded metal insert in cast iron shoes.

The figures shown in the table are the net saving and relative cost based upon prices of the shoes as bought in Canada, the prices are at Canadian rates and are given so that the saving based on other prices can be readily determined.

"Extra long eggs are the principal cause of egg breakage in transportation;" presumably meaning that long eggs, because of their length, do not fit well in the racks which are supposed to contain them and to keep each egg from disturbing its neighbor. This statement, taken from the Express Gazette Journal, is given as the opinion of men in the claim department of the American Railway Express. The editor says that the egg wisdom which he is here dispensing comes from a bulletin, by O. M. Wilbur, which has been issued by the University of Maine. Rhode Island Reds produce heavy eggs and Wyandottes are recorded as laying the smallest size. It is proposed that the hens should be invited to a conference on standardization.

Future possibilities of the locomotive boiler

Trend to high boiler pressures indicates a serious consideration of the watertube type

By Louis A. Rehfuss

IN the last 50 years, steam locomotive development has followed lines that have been conservative to say the least, save in the one item of increasing size. Most of the great developments really occurred prior to 1850. Since that time the designers have been conservative, yet hardly progressive. They have been content to refine, to elaborate, to improve the original design. There has been little disposition to go back and question the first principles, to determine whether or not the traditional type of steam locomotive was all that it might be. Of late locomotive design seems to indicate signs of a change.

In increasing the thermal efficiency of the steam power plant, the subject may be approached in two directions, up or down, widening the range from higher pressures to lower back pressures or vacuums. Recent experiments with turbine condensing locomotives have had to do with the extension of this range downward to work with vacuums with which the boiler has nothing to do, since it is a question of the utilization of the steam after it is made. On the other hand, with the extension of the range upward the boiler has a great deal to do, and it is with this phase that this article would treat.

Trend toward higher pressures

The first steam locomotive successfully developed by James Watt, worked at a pressure of seven pounds. To-day the steam locomotive boiler operates at a pressure of 200 lb., and is apparently at its limit unless radical changes in its design are made. That these changes are at hand may be seen in the 350 lb. pressure locomotive boiler built for the Delaware & Hudson as well as in the 40 or 50 Brotan type boilers recently built for heavy railroad service in Hungary. These boilers dispense with the stayed back end and use walls of water tubes for the firebox, but still cling to heavy plate barrels, made heavier than ever to stand the pressure.

The whole reason for this trend towards higher pressures lies in the fact, that while the total heat to be imparted to a pound of water remains practically the same at all pressures, the heat of vaporization, which is never available as mechanical energy, steadily decreases as the pressure increases. This means that as the pressure rises a steadily increasing percentage of the heat is available as useful work. Theoretical savings, of course, are larger than practical, because of the greater condensation occurring at the higher temperatures used and other factors. Still with proper superheating to minimize the condensation and with normal precautions in design, undoubtedly the possibilties in increased thermal efficiency and coal economy point to increasing our boiler pressures to as great a degree as boilers and engines can be built to withstand them safely.

In the face of this plain trend of the future, what is the outlook for the steam locomotive boiler of to-day. Unfortunately the existing type will not lend itself readily to any considerable increase over present pressures, due to the question of the weight limitation on drivers and other factors.

With a barrel six or eight feet in diameter, locomotive boiler plates are already assuming alarming thicknesses and weights, so that even with a six-foot barrel, the thickness of boiler plate would be close to two inches for a 500-lb. pressure boiler, and nearly four inches for a pressure of 1,000-lb. With driving wheels already loaded to the maximum, doubling or tripling the weight of the present type of boiler through an increase in the pressure would soon impose a practical limitation to the extent of that pressure's increase. The difficulty of preventing heavier plates, where exposed to the fire, from burning, would be another limitation.

It seems likely that the trend of the times is passing from a fire tube to a water tube type of boiler. This is partly foreshadowed in the D. & H. boiler and the Brotan boiler. Still higher pressures are likely to witness a still further application of water tube boiler principles on the barrel itself.

The reason for this is plain. Since the thickness of the plate varies as the diameter of the tube, barrel or drum holding the pressure, it is evident that a 3-in. tube with walls but 1/4 in. thick will hold safely as high a pressure as a boiler barrel 6 ft. in diameter with walls several inches thick. Herein lies the solution of the difficulty, and herein lies the adaptability of the water tubes boiler to the high pressure steam locomotive of the future.

Objections to a water tube boiler

Many objections may be raised to a conclusion of this kind, and particularly to the use of an all-water tube boiler. It seems worth while here to consider a few of them:

1—Will the joints stand the rack and tear of locomotive service?
2—How will radiation be prevented to the outside air?
3—How solve the high temperature difficulty?
4—Lessened water and steam capacity.
5—The question of safety.

The first objection likely to be raised is that the joints will not stand the rack of locomotive service. The present fire-tube locomotive boiler has approximately 200 tubes ranging from 15 to 20 ft. in length, which are absolutely unsupported except for rolling and beading at the ends. Suppose now the fire, or rather the furnace gases, are put outside the tubes and the water inside. This would not lessen the resistance of the joints to shock. If the weight of the water in the tubes increases the shock, there is still recourse to two expedients seldom used in locomotive boiler practice. The first is to place baffle plate supports at several points along the length of the tubes. With the furnace gases playing outside the tubes and therefore occupying a larger area, diverting the flames back and forth in their course is sound practice in water tube boiler construction. In a locomotive boiler, these baffle plates would help support the weight of the tubes

as well, thus preserving them from too great a strain from the effects of their own weight. Where tubes give trouble from slipping and are required to carry an unusual load, the slipping point can be easily raised by serrating with an ordinary tube expander, the rolls of which are grooved .007 in. deep, 10 grooves to the inch. A tube thus serrated would have its slipping point raised between three and four times its usual value.

A second objection to the use of the water tube boiler for locomotive service is the question of the radiation of the heat to the outside air. With the locomotive rushing through space this is plainly of the greatest importance. When using a water tube boiler the hot gases pass outside the tubes instead of through them, and this heat must be confined. An outside shell lined with firebrick offers the best solution to this difficulty. Even in the customary fire tube type of locomotive boiler, it seems strange that firebrick has not been used more in connection with the firebox.

Objections to a waterleg type of firebox

The firebox construction of the D. & H. and Brotan locomotive boilers, in which water tubes are used for waterlegs, is an improvement over the stayed firebox side from the standpoint of improved circulation that keeps sediment from collecting. They are both inferior to straight firebrick walls, with water tubes used overhead in place of a crown, for several reasons.

The waterleg construction, in which the water cooled metal surface comes in contact with the fire itself, chills it and prevents it from burning to its best efficiency, causing coal only partially consumed to go in the ashes. The burning gases above, that are brought into premature contact with water cooled surfaces may well be lowered below the point of complete combustion, leaving valuable heat units to go up the stack. For these reasons it is not best to overload the firebox section with excessive water cooled area, even though such evaporative area, at the point of highest heat, is obviously most effective for evaporation.

By the use of firebrick walls, the evaporation that would be normally done by the waterlegs at the fire is simply transferred to the tubes, which become much more effective because of the higher temperature of the furnace gases. No evaporation is lost. Rather it is gained through the more thorough combustion of the coal possible with firebrick walls which reflect the heat instead of absorbing it. Evaporation in the firebox itself is not lost, since a nest of water tubes would be used overhead in place of the present unsafe crown sheet of the firebox.

It is also obvious that firebrick walls would prevent radiation to the outside air to a greater degree than is possible with the waterleg firebox. This can be understood from the fact that the heat conductivity of water is four or five times as great as that of firebrick. All told, a simple wrapper sheet lined with firebrick, with water tubes overhead, should be not only less expensive than an elaborately stayed firebox, but more effective in service.

In the case of a water tube boiler, firebrick could also be used to line the barrel, varied if desired, near the smokebox end by a circle of tubes carrying the feed water, which could be preheated and purified before entering into the boiler, while serving the purpose of preventing radiation to the outside air. For holding the firebrick lining, whether in the firebox or barrel, the key bricks could be molded with a bolt end projection, permitting them to be bolted fast to the walls of the shell. Overhead, the brick would rest on top of the top layer of tubes.

Question of high steam temperatures

A third objection urged, not so much to the use of water tube boilers as to the use of high pressures, is the question of steam temperatures. Modern steam machinery is limited in its capacity to stand excessive temperatures. Even so, it is the practice to use high superheats, so that final temperatures of 600 deg. to 700 deg. are not unusual. Were no superheat used, these temperatures would correspond to saturated steam pressures of several thousand pounds. Steam at 500 lb. pressure in the saturated condition has a temperature of 470 deg. so we can still use a moderate superheat of 130 deg. and have but 600 deg. as the final temperature. Using saturated steam pressures of 1,000 lb. at 548 deg. there can be added still an initial superheat of 100 deg. and keep well inside the 700 deg. mentioned above.

In place of using a high initial superheat, the policy here would be to use a moderate initial superheat, expand the steam in two stages, which would be preferable with the high pressures employed, and superheat between the stages. Losses from condensation, one of the principal functions of superheating, would be thus overcome. Superheating at the intermediate stage would be more effective because the difference in temperature between the steam and the furnace gases would be the more pronounced.

A fourth objection to the use of water tube boilers for locomotive service is the lessened steam and water capacity involved. The area outside of the tubes now filled by the water in the fire tube boiler is greater than the cross sectional area of the tubes, so that the fire tube boiler of the same overall dimensions does have the greater steam and water capacity. However, because of this very fact, the average particle of water in the water tube boiler is at all times closer to its heating medium, so that steam can be obtained much quicker. In properly designed water tube boilers steam may be raised from a cold boiler to 200 lb. pressure in less than 30 min. This quick steaming makes large water and steam capacity unnecessary.

The necessity for high steam capacity is obviated by the use of high pressures. Thus a pound of saturated steam at 500 lb. pressure occupies but .90 cu. ft., contrasted with the 2.14 cu. ft. occupied by saturated steam at our customary 200 lb. pressure. When the increased power available in the higher pressure steam is also taken into consideration, it will be seen that the steam capacity with a 500 lb. pressure need be but a third that used in the normal 200 lb. pressure employed to-day, even without the advantage of the quick steaming already mentioned.

From the viewpoint of safety the water tube boiler has much to recommend it. Disastrous explosions where the whole crown sheet gives way, such as are yearly occurrences on locomotive boilers, are scarcely possible with water tube boilers. They are designed so that the steam and water drums are seldom brought into direct contact with furnace gases until after these gases have lost their power to do harm by contact earlier with a mass of water tubes.

The positive, swift circulation of the water, which is a feature of most water tube boilers is also one of their surest guarantees of safety. Not only does this circulation tend to keep all parts at a more equable temperature, but it also lessens scale deposition, which causes burning, while the upward surge of the water at the firebox end, where most of the steam is formed, prevents any section from being left dry from low water conditions. This same factor of superior circulation is one of the best features of water tube boilers as a whole. Besides promot-

ing safety, it positively increases the evaporative efficiency per square foot of tube surface.

The greater area of section occupied by the furnace gases around the tubes extends the combustion space, so that the tubes can be brought nearer the fire than might otherwise be deemed advisable. This greater area also lessens the friction encountered by the furnace gases in their path to the stack and decreases the necessity for high vacuum exhausts in the smokebox. Too easy a passage for the gases, which would result in their going up the stack at too high a temperature and wasting heat, is prevented by the appropriate use of baffle plates, diverting the gases back and forth across the tubes and lengthening the contact of the hot gases with the tubes.

The above are some of the many advantages that might be opened up by the use of water tube boilers in steam locomotive practice. Whether or not these advantages might be enjoyed without other great disadvantages would depend to a considerable degree upon the ability of the designer to make the best use of the limited areas within which he would be called upon to work. A water tube locomotive boiler could not reasonably depart very far in its general outside dimensions and shape from the present fire tube type. It would still have to be of limited cross section to meet clearance limits and extend itself principally in length.

The moral side of apprentice training

Too much emphasis cannot be placed on its importance and practical value

By F. E. Lyford
Apprentice instructor, Lehigh Valley

THE development of an apprentice school requires more than a consideration of the courses to be taught, equipment needed and rules for its operation. An investigation will show that to obtain the most good from such an organization, a study must be made of certain things which are sometimes overlooked. The operation of an apprentice school should be looked upon as a human engineering problem dealing with tremendously flexible, plastic material. The opportunities for molding this material along the light lines and giving young men a trade education are great, but often the matter of educational training is looked upon as of prime importance, whereas the moral training in co-operation, loyalty and square dealing should receive much thought.

The reason for the existence of an apprentice school is not merely its production of better trained men, for there are many other important results that should develop from its influence. These may be summed up as follows: The development of loyalty and co-operation, the discovery of supervisory material, the formation of the habit of thinking things out along the right lines, and the acquisition of a background of correct information, which tends to prevent the growth of a spirit of unrest and dissatisfaction, generally due to an ignorance of industrial relations. To provide even a few young men with such a background is a matter of benefit to a corporation.

The development of the school plan should consider the subjects to be taught, the equipment to be used and the scheduling of lectures in various lines, with the certainty that the supervisor of apprentices will realize the proper relation between technical training and the development of the moral issues spoken of above. An insistence on thinking problems through by applying correct principles, together with a course in industrial history and explanations of industrial relations, will produce men trained and capable of looking on both sides of questions arising between employer and employees, with some judicial ability to properly weigh the problems involved.

Vital factors in apprentice training

Among the many things which contribute to the complete success of an apprentice school are the following factors: Personal contact, understanding the boys' point of view, especially in regard to their own dreams of what they have in mind for themselves; vocational guidance carried out as far as conditions allow; knowledge of the industrial problems confronting the apprentice; fairness and justice; keeping faith; a certain amount of contact of apprentices with superior officials, and giving the boys definite opportunities to assume certain responsibilities. These factors all deserve considerable study and in the following paragraphs, brief statements are made which explain what they mean, and touch upon effects which they produce on the successful operation of the apprentice school.

Personal contact means more than merely knowing each boy in the class room or shop. The outside interests which the outstanding boys have should receive the approval or disapproval and a little time spent with a few of the leaders will bring good results in getting all the boys interested in worthwhile affairs. Such affairs are largely a matter of the environment and local surroundings, but music, athletics and books are always things toward which to guide a boy's thoughts. Appreciation of the interest shown is quick to come in many cases and leadership is thus made easier. The outstanding boy is mentioned and the emphasis should be placed on such boy or boys. By taking one boy, cultivating his talents and abilities, and making a noticeable change in his actions and expressions, there will be a tendency among the rest to try to excel in order that they may be chosen to be so advertised later on, for all are quick to see the value of public appearance, some special privileges, or even a speaking relationship with officials.

Most boys have dreams as to their futures, and often times these dreams are very tenderly cared for and are kept away from the sight of interested eyes, especially the eyes of parents. The apprentice instructor is often the one who will be allowed to behold this dream, and if the boy feels his sacred ideas are receiving due respect, he will open out and tell his dreams and ambitions to the instructor in such a way that much help can be given him to attain these ends. This characteristic is one that must be studied and the boy's point of view must be used when it is studied. Too many plans have received a laugh be-

cause the one hearing them had no sympathy, no understanding of a boy, and no realization that the far flung goal of a boy's ambition has been reached many a time in far less years than even that boy had planned. Sympathetic analysis of a boy's desires and his natural ability will do much toward guiding him to the place where he can make the most of himself and his life. Many irresponsible troublemakers will, if guided aright, be changed into earnest, industrious workers. A complete personal survey to determine each boy's desires and capabilities will be well worth the time it takes.

This survey and study logically become the first steps in vocational guidance, which should be carried out as far as time and facilities permit. It is here that close cooperation with the employment department will help solve many problems. To be able to turn to the apprentice school and find men who have expressed themselves desirous of working on certain jobs and have studied such jobs, will assist the employment department in giving the best service. On the other hand, the instructor should be able to place certain men with outstanding characteristics in the places for which they are best fitted by consulting the employment department as to vacancies, etc. The right man in the right job is a big factor in the success of every organization, and it is worth time and study to accomplish this even in a small way. In his relations with the apprentices, the instructor must correct from the very start the tendency to take the opportunities offered in the apprentice school for granted, and he must inspire the boys to do their utmost so that they may receive the fullest benefit from their work.

Looking through the boys' eyes

It is only correct to assume that the supervisor must have a close knowledge of the industrial problems confronting the apprentices. He should know their working conditions, their living expenses, the probable irritating points in their work and must see all these through the boys' eyes as nearly as possible. The variation in dispositions of foremen and fellow workmen should be studied, and the boy should be taught to consider this matter in his dealings with foremen and others throughout his career. The importance of the relation between wages and expenses during the low pay periods should be thought of, and every effort should be made to encourage boys supporting themselves to win through this time, until they reach more or less financial independence through the natural increases in their pay.

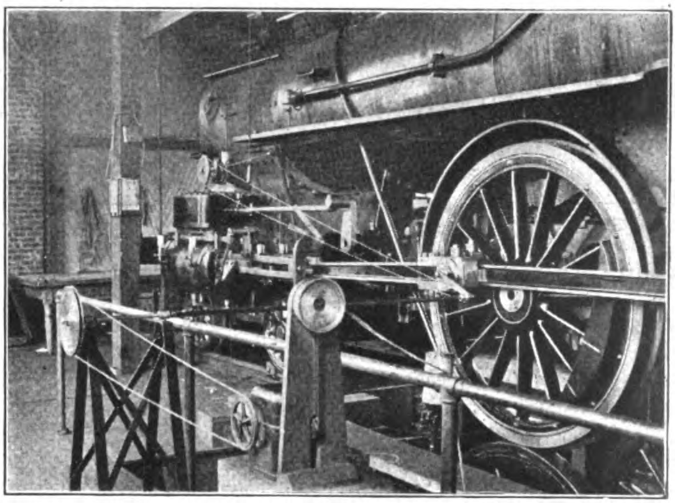
The apprentice supervisor must be fair and just in all his dealings and must see that the company also keeps faith in its relations with the apprentices. It must never be forgotten that these boys are in a state of flux and impressions made at this time will leave an indelible mark. So, the supervisor must himself be fair and just, he must see that the foremen treat the apprentices properly and he must not make any statements to the apprentices that he is not certain that the company will carry out, through his knowledge of its policies. If boys are promised changes in work, no matter how rushed or overworked an instructor may be this promise must be fulfilled; if a threat to discharge is made for repetition of a certain offense, this must be carried out, and thus will be built a system, founded on the boy's faith in this system through his own knowledge that he is receiving a fair deal, that he is a member of an organization that has a definite purpose and is seeing that this purpose is carried out in all fairness and at all costs.

Contacts with officials

It is a stimulus to work, especially among young men, if the superintendent or higher officials make occasional visits to the schoolroom and perhaps, say a few words. The feeling engendered is valuable and is sure to increase the boys' interest in their school work. These little contacts are thought about and spoken of by all boys, for acquaintance with supervisors always appeals strongly to a boy. Much good is done, also, for boys are quick to defend those who are showing an interest in their welfare.

One of the best ways to find out how much an apprentice has learned during his course, how much initiative he has and what responsibilities he is willing to assume, is to bring him to the apprentice instructor's office for at least one month's work during the last two or three months of his apprenticeship. Usually there are many sketching jobs to be done, and by sending the apprentice out to do this work and letting him take the responsibility of procuring all the necessary information for the completion of the sketch, even to making a tracing and blueprint, he will quickly show his training and capacity for handling bigger jobs. If mistakes are made and corrected during this period, the background of his previous training will take on a new value, and he will perceive the use of many things he has learned. Such a period, in close every-day contact with the apprentice instructor, gives him confidence in his training and the knowledge that the tools he has learned to use are good tools that can be depended upon. At this time, the apprentice obtains a view of the shop organization as a whole and learns the interdependence of the various departments. The problems of supervision, also, come to his attention and he sees, perhaps for the first time, the many interesting problems which lie ahead of him. Here he is given a taste of responsibility and can also see the responsibilities that have to be assumed by others.

The multitudinous phases of any work with growing boys are too difficult to cover completely in a short discussion of this great subject. For that reason, the foregoing paragraphs are intended, merely, as an outline of one of the sides of apprentice work which has not, perhaps, received the consideration and study which is due it. That these ideas are of real practical value is being proven daily in the apprentice school of the Lehigh Valley system shops at Sayre, Pa. The returns to an organization from moral training may easily be worth many times the value such an organization might receive from technical or trade education alone. To properly combine the two is, of course, ideal, and like all ideals, much investigation and study must be given the methods to attain it.



Indicating and recording apparatus of the locomotive testing plant at Purdue University

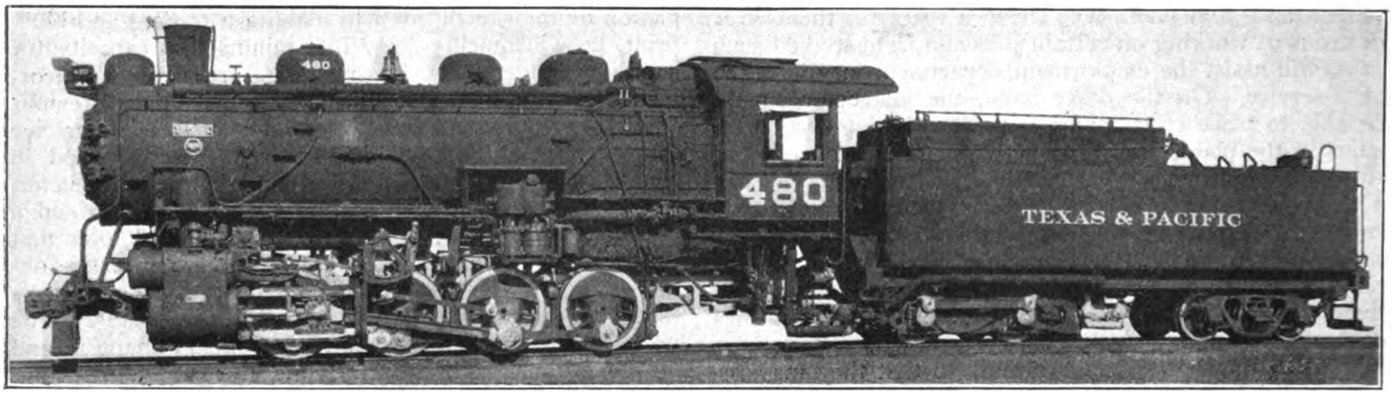
Texas & Pacific eight-wheel switchers

Tractive force of 54,000 lb.—Application of tender boosters to two locomotives gives an additional tractive force of 15,000 lb.

A NOTABLE feature of locomotive development during recent years has been the improvement in the design of switching locomotives, with a view of increasing their capacity and efficiency. The present-day heavy switcher is often specially designed for the work to be done, and is equipped with much the same fuel and labor-saving devices which have been used with conspicuous success in high-powered locomotives for road service.

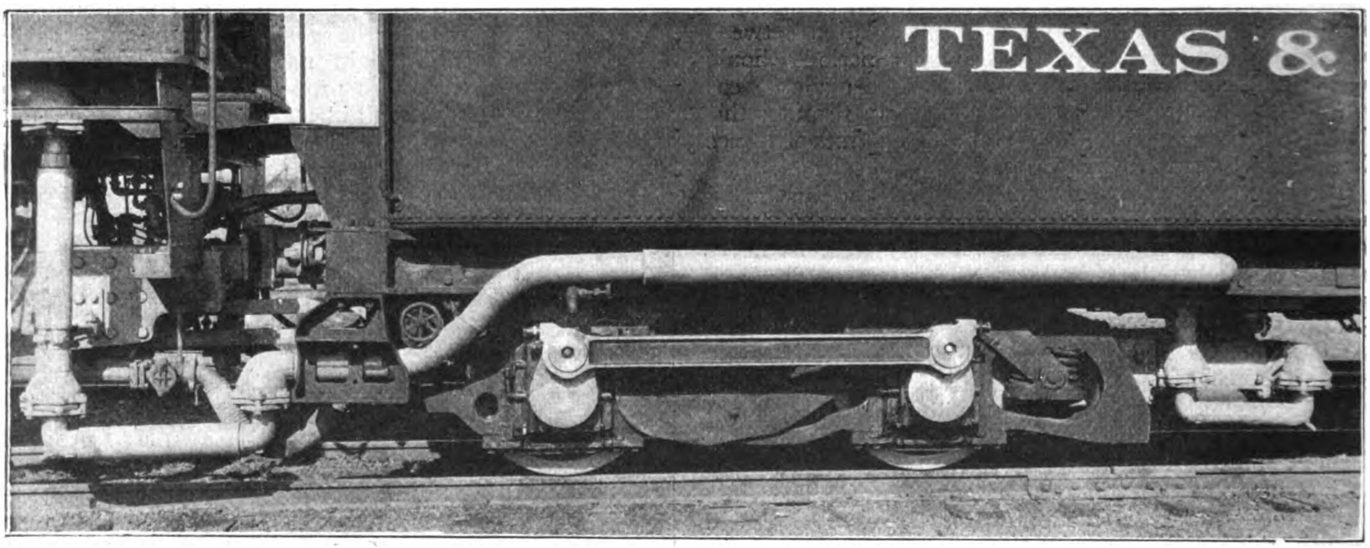
Among the outstanding switching locomotives which have thus far been built are ten recently completed by the Baldwin Locomotive Works for the Texas & Pacific. The locomotives have the 0-8-0 wheel arrangement and, although not the heaviest of their type, are designed to develop maximum power output within the weight limitations imposed. They are built to operate on curves as sharp as 22 deg. and grades up to three per cent and develop a rated tractive force of 54,500 lb.

These locomotives are designed to handle the heavy yard work in the terminals out of which the road's heaviest road locomotives operate. They are called upon for helper service out of the Marshall, Tex., and Baird yards where it is necessary to help full tonnage trains over grades from two to four miles in length. Some of the new engines have also been assigned to transfer service in the Fort Worth, Tex., and Shreveport, La., terminals.



Texas & Pacific eight-wheel switcher with Franklin tender booster

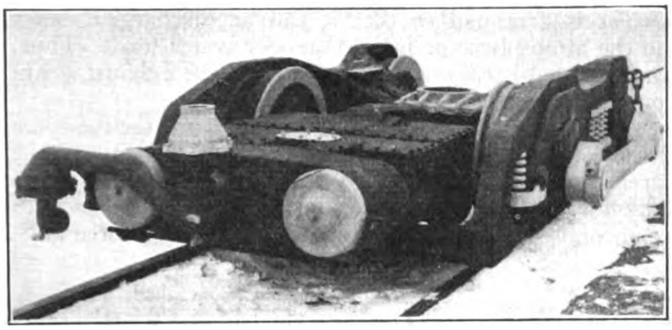
Two of the locomotives are equipped with boosters applied to the forward tender trucks, giving these engines a total maximum tractive force of 69,500 lb. in forward motion. This additional tractive force is provided to handle at one pull 800 tons on and off a transfer boat operating across the Mississippi River at New Orleans, La., up inclines with grades of about four per cent. With present switching power it is necessary to make two or three trips on and off the boat when it is loaded to capacity which materially delays the movement of traffic across the river. One of the locomotives is assigned to service on each side of the river.



The steam pipe connections to the booster

An important feature of these locomotives is the limited maximum cut-off with starting ports. The Pennsylvania

has used this construction for a number of years in heavy road engines and more recently has incorporated it in the design of eight-wheel switchers. It has also been applied to road engines for the Texas & Pacific and other roads. In the Texas & Pacific switchers the cut-off is limited to 65 per cent of the stroke. As locomotives of this type operate a longer part of the time in full gear cut-off, it is evident that limiting the maximum cut-off must result in a very high economy in the use of fuel and water. The starting ports, which are an essential feature of the limited



A rear view of the booster truck, showing the engine in place

cut-off, provide means for readily and quickly starting the locomotive in either direction. Compensating ports are also provided in the head end of the valve bushing. The function of these ports is to lengthen slightly the cut-off on the head end of the cylinder, thereby increasing the tractive force without a corresponding decrease in the minimum factor of adhesion. Plugs are provided in the side of the steam chest opposite the starting ports for cleaning purposes.

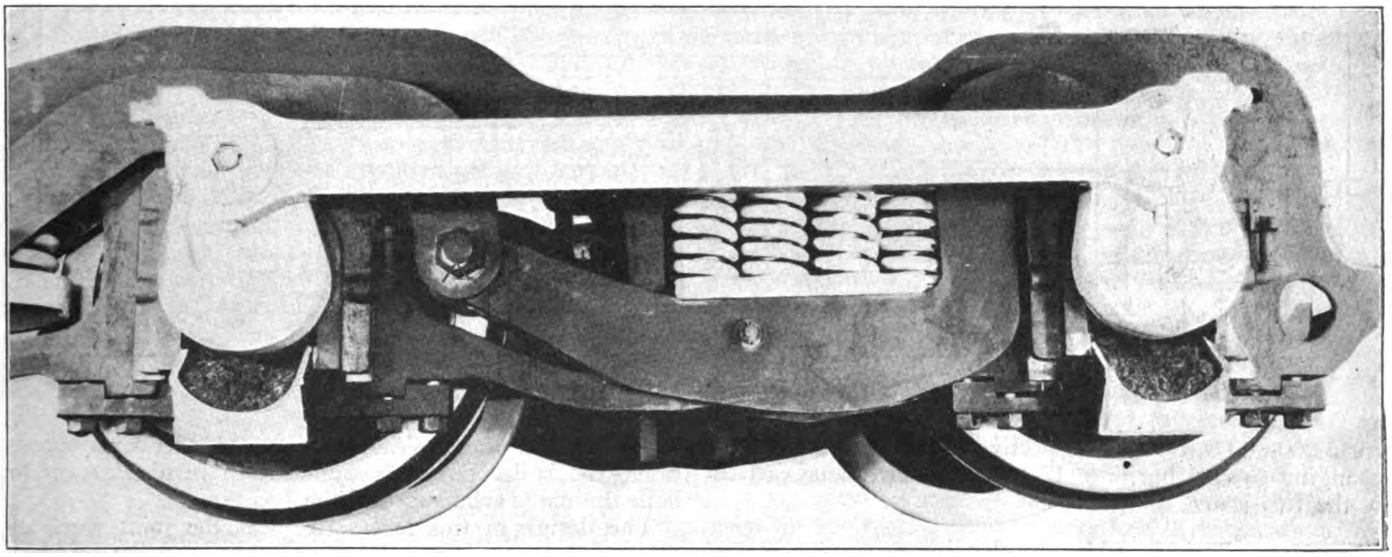
The valves are set with a maximum travel of 8¾ in., vanadium steel; and crank pins and valve gear forgings, with the exception of the eccentric rods, of the same material. The main crank pins are hollow bored. The crossheads are of the alligator type, with chrome-vanadium steel keys; and the guides and guide yoke are of most substantial construction, designed for severe service.

The main rods are of the articulated type, distributing the load between the crank pins of the third and fourth pairs of driving wheels. Floating bronze bushings are used on the intermediate side rod connections. The main and side rods are of normalized carbon vanadium steel. Heat treated steel is used for the driving axles, which are hollow bored. The play between rails and flanges is 13/16 in. on the front and back drivers, and 9/16 in. on the intermediate and main pairs.

The frames are 5 in. wide, and special attention has been given the transverse bracing in order to insure ample strength and preserve alinement in severe service. Fillets of liberal radius are used throughout, and each frame is cast in one piece with a single front rail of heavy section. The pedestal wedges are of the self-adjusting type.

The boiler has a straight top and carries a working pressure of 250 lb. At present the locomotives are equipped for burning oil, but they are so designed that they can be readily modified to burn coal if desired. The Booth burner is applied, and the equipment is arranged in accordance with the railroad's standards. The firebox contains two thermic syphons.

Liberal use is made of flexible bolts in the staying of the firebox. There is a complete installation in the throat and about 67 per cent of the bolts in the side and water legs are of the flexible type. Flexible bolts are used in the two outside rows and upper corners of the backhead and flexible crown bolts are placed in the three transverse rows at the front of the firebox and in the three outside rows on each side of the top center line.



The equalizers are arranged to support the cylinder overhang at the left

the steam lap is 2½ in., the exhaust lap is ⅛ in., and the lead is ⅛ in., and the steam distribution is controlled by the valve motion of the Baker type, controlled by a power reverse mechanism.

The cylinders are of cast steel with outside exhaust passages, each cylinder being made in one piece, with a half saddle. The cylinder barrels are bushed with gun iron. Effective lubrication at all times is assured by the use of both a hydrostatic and a mechanical lubricator.

Machinery details include piston heads of rolled steel, with gun iron bull rings; piston rods of normalized carbon

The throttle valve is placed in the smokebox and is connected with the dome by an internal dry pipe having a shut-off valve at its rear end. With this arrangement, the superheater is filled with steam at all times, and superheated steam can be used for the auxiliaries. The Type A superheater has 34 elements.

The boiler accessories include two steam turrets, one for saturated and one for superheated steam, which are both placed in front of the cab. All the valves have extension handles, properly labeled and conveniently located for the engine crew. The saturated steam turret

has connections for the injectors, fire extinguishers, cab steam heat, squirt hose, and power reverse, while the superheated steam turret supplies the air pump, blower, the headlight turbine, and all oil-burning steam connections. This turret is supplied by an outside steam pipe, placed on the left side of the boiler and properly designed to allow for expansion.

The fire extinguisher, to which reference has been made, has two water inlets, one connected to the tank and the other for coupling to a fire plug. The locomotive carries 50 ft. of 2-in. fire hose.

The cab is steam heated, equipped with Lima seats and with a clothes locker for the crew. The tools are carried in a combination tool and sand box placed in the front of the tender tank. The running boards are straight and are placed as low down as possible. This, in combination with a long, low tank, gives the engineman a clear view in both directions.

The tender has a Commonwealth cast steel frame made in one piece. The oil and water tanks have capacities for 3,000 and 9,500 gal., respectively, and, in the event of changing to coal burning, 12 tons of coal can be carried in the fuel space.

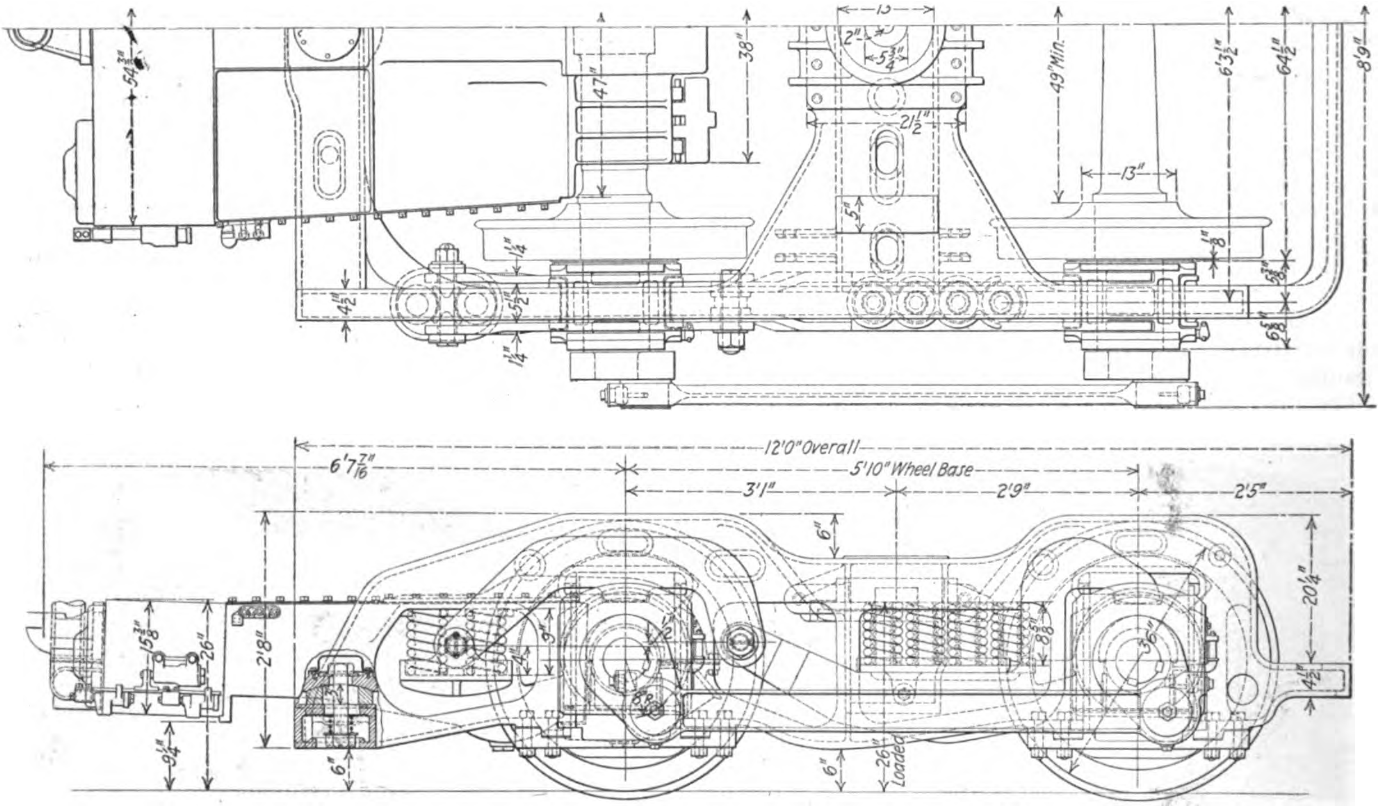
The Franklin tender booster

As has been mentioned, the tenders of two of these locomotives are equipped with boosters furnished by the Franklin Railway Supply Company. The booster is mounted on the front truck, which is of unique design. The frames are made in one solid cast steel piece, with a cross transom at the rear end to support the booster engine, similar to the familiar support of the booster on locomotive trailing trucks. A unique feature regarding the equalizing of this truck is, that it is arranged so that a greater proportion of the load comes on the wheel that is directly driven by the booster, thereby relieving the side rods of all unnecessary strain. The truck frame construction and equalizer system are shown in the illustrations. The arrangement of the booster engine on the truck provides great accessibility for any attention that it may need.

The truck is fitted with 36-in. wheels and the journals measure 9 in. by 12 in. They have ordinary surface bearings lubricated in the standard manner as is customary with tender trucks, and one of the illustrations shows the ease with which the cellars may be removed for repacking. The side rods are made of carbon-vanadium steel.

The booster is piped to take superheated steam under the control of the main engine throttle, supplemented by the regular automatic booster control. The booster exhaust is arranged so that it can be discharged either into the atmosphere or into the tender water tank. Thus, it is possible to recover the heat units in the exhaust steam from the booster.

With the use of the booster, the maximum tractive force of the locomotive alone, amounting to 54,500 lb., can be increased by 15,000 lb. This fits these locomotives especially for hump yard service, or for work where inclines are encountered and exceptionally high tractive force must be exerted for short periods of time. Under such conditions, the boiler power is sufficient to furnish steam to both the main cylinders and the booster.



Assembly drawing of the Franklin tender booster

The design of this locomotive was the joint work of the railway's motive power department and the builders and was supervised by A. P. Prendergast, mechanical superintendent of the Texas & Pacific. The cab fittings were located under the personal supervision of R. W. Salisbury, mechanical engineer of the railroad, and the resulting arrangement is exceedingly convenient. The accompanying table of dimensions and proportions gives further particulars concerning these locomotives.

Table of dimensions, weights and proportions of the Texas & Pacific 0-8-0 type of locomotive

Builder	Baldwin
Type of locomotive	0-8-0
Service	Switching
Cylinders, diameter and stroke	22 in. by 28 in.
Valve gear, type	Baker
Valves, piston type, size	12 in.

Maximum travel	8¾ in.
Outside lap	2½ in.
Exhaust clearance	⅛ in.
Lead in full gear	⅛ in.
Cut-off in full gear, per cent	65
Weights in working order:	
On drivers	230,870 lb.
Total engine	230,870 lb.
Tender	197,130 lb.
Wheel bases:	
Driving	15 ft.
Total engine	15 ft.
Total engine and tender	55 ft. 4½ in.
Wheels, diameter outside tires:	
Driving	51 in.
Journals, diameter and length:	
Driving, main	11 in. by 12 in.
Driving, others	10 in. by 12 in.
Boiler:	
Type	Straight top
Steam pressure	250 lb.
Fuel	Oil
Diameter, first ring, inside	78 in.
Firebox, length and width	102 1/16 in. by 75¼ in
Tubes, number and diameter	199—2 in.
Flues, number and diameter	34—5 in.
Length over tube sheets	15 ft.
Grate area	53.4 sq. ft.

Heating surfaces:	
Firebox	176 sq. ft.
Thermic syphons	55 sq. ft.
Tubes and flues	2,284 sq. ft.
Total evaporative	2,515 sq. ft.
Superheating	574 sq. ft.
Combined heating surface	3,089 sq. ft.
Tender:	
Style	Water leg
Water capacity	9,500 gal.
Fuel capacity	3,000 gal.
Journals, diameter and length, front	9 in. by 12 in.
Journals, diameter and length, back	6 in. by 11 in.
General data estimated:	
Tractive force	54,500 lb.
Tractive force, tender booster	15,000 lb.
Total tractive force, locomotive and booster	69,500 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	4.28
Total weight engine ÷ comb. heat. surface	91.6
Boiler proportions:	
Tractive force ÷ comb. heat surface	17.6
Tractive force × diam. drivers ÷ comb. heating surface	9.00
Firebox heat. surface ÷ grate area	3.3
Firebox heat. surface, per cent of evap. heating surface	7.02
Superheat. surface, per cent of evap. heating surface	22.8

The foreman's responsibilities*

Leaks of all kinds must be stopped—Relations with employees and with the public

By Frank J. Borer

Freight shop foreman, Central Railroad of New Jersey, Elizabethport, N. J.

"The locomotive is only as good as its boiler," fittingly reads the heading of an advertisement on the front page of the magazine. It would be appropriate to say the "the foreman is only as good as the education and training he has received."

The opportunities of the foreman are many and to grasp or seize them he must train himself and never cease to grow in knowledge. Moreover, knowledge is of no value unless properly applied. Fine sentiments without action to back them up gets one nowhere. The foreman is measured by final results—production, quality and quantity of work done and cost at which produced.

Each foreman, whether he supervises six or six hundred men singly or jointly with other foremen, should be properly charged with any inefficiency, irregularities or low morale of the men and consider this a liability on his "balance sheet." He should be just as much interested in clearing off this "debt" as in paying his annual tax bill.

Leaks of all kinds

Who is this foreman about whom there has been so much said in recent years? Let us put him under the searchlight for a moment and analyze him. Are there any leaks in his department, and if there are, has he used all the means at his disposal to stop them? How about steam, water, gas, light and power leaks? How about coal, oil, waste and all kinds of material leaks? How about time leaks? Men not starting promptly on time or washing up before the whistle blows? Did you ever figure the loss on account of this last item alone? As an example, let each man in a railroad shop employing 1,000 men quit work ten minutes before the whistle blows at night, and figure the wages paid just at 50c an hour. At this rate of pay, the loss to the railroad, per year of 300 working days, would be $25 per man, or $25,000 for 1,000 men—enough money to purchase about 10 new freight cars.

There is a possibility of a "leak" by machines not working to capacity. Men waiting for material or having to walk too far for material or tools are other items needing careful watching by foremen. Then there is the fellow who wants to enjoy a quiet smoke at some secluded spot every morning and every afternoon for a half-hour or so until the foreman "discovers" the "leak." Don't tell me there are none of them in your shop, for there are several of them in every shop, or maybe you have his prototype in the form of the fellow who always has to tell everybody how much work he has to do, and loses so much time on this account that he is really always behind unless checked up.

There are other numerous "leaks" ready to develop, such as wrong material, or not enough or too much material furnished to the men. Surplus material laying around gets spoiled, or finds its way to the scrap heap. Material may be incorrectly laid out. Then there is poor workmanship due to wrong or insufficient instructions, or wrong assignment of men—scrap laying in passageways has been an indirect cause of many accidents—heating furnaces or rivet heating forges in full blast before forgings or rivets are nearly ready to be placed in them—allowing mechanics to stroll around the shop looking for material when this should have been attended to by helper or laborer.

These are all sins chargeable to the foreman, if they exist, and they surely are leaks in the treasury of the railroad.

Constructive suggestions

The opportunities of the foremen lay in making constructive suggestions and recommendations as to labor saving devices, or short-cut methods to greater economy in the use of power and shop facilities in general; improving and standardizing car and locomotive parts; find-

*Submitted in the Railway Mechanical Engineer competition on the foremen's responsibilities and opportunities.

ing the best ways and means of using obsolete material for other purposes; reclamation and preservation of lumber; reclaiming various parts for locomotives and cars by means of welding and cutting or other means; proper selection, preparation, use and care of tools and devices, grinding wheels, jigs, gages and templets; suggestions for overcoming car and engine failures.

Prevention of accidents is another field where the foreman can find much that needs his continued attention.

The locomotive department foreman has many exacting responsibilities if the finished locomotive is to be as nearly as possible 100 per cent efficient when released for service. By careful supervision he can often correct a defect that would reduce the locomotive mileage between shoppings thousands of miles if the defect had not been discovered.

The car department foreman must keep himself and those under his supervision posted in regard to the A.R.A. rules of interchange and loading rules. Much money may be lost by a railroad through wrong interpretation or ignorance of the rules on the part of its foremen. Incorrect or insufficient billing information, incorrect defect carding for improper or wrong repairs, receiving of cars in interchange not in compliance with the rules, careless inspection of cars before loading, will cost the railroad large sums of money. Such "leaks" are often hard to discover.

Then there is his job of chief inspector of his department or sub-department. Does he correct mistakes made by his men? If not, he is not making good. Take a truck archbar for illustration. Someone laid it out inaccurately. It measures 3/16 in. more between wheelbase centers than it should. If applied it will cause excessive wheel flange wear from the start, necessitating removal of the wheel in perhaps six months instead of six years. Would it not be much better to either upset the archbar to the correct length or to scrap it?

Attitude toward employees

But the foreman has other responsibilities and opportunities. There is the apprentice that needs a word of encouragement, instructions and advice to create an incentive for efficiency and economy. The laborer is not always given the consideration he deserves in instructing him in assorting and handling material and in making his job more attractive, not by giving him mechanic's wages or by painting his shovel or broom handle a golden yellow, but by simple human kindness, by a full realization that his services are just as essential as those of the mechanic, by teaching him the a. b. c. of saving usable parts from scrap, by making him take a deeper interest in keeping the shop clean, aisles between cars and locomotives and around fire hydrants clear of obstructions and by removing fire hazards around the property on his own volition.

Putting the searchlight on our foreman from another angle, we find that if he is to be a successful supervisor, he must be impartial, have sobriety in temperament, and not fritter his idle hours away in excesses of any kind. His department will gain or lose in strength, and in efficiency exactly to the extent that he is able to properly carry out the policy and orders of the higher officials. It all depends on how much effort he puts forth to overcome the difficulties and complexities of daily contact with the men and the management. To lighten the burden of responsibilities, it is well for the foreman to be diplomatic and conciliatory. He should make it a particular point to be easily approachable, and seek and welcome constructive criticism and suggestions and contact with the men, and use his authority to discipline or dismiss employees with the utmost care and justice, without passion.

"Don't be over ambitious if you want to be successful," advises Otto Kahn, the well-known American banker. In a recent message to young business men, he set forth in part the following as principles for success: "It is important to perform minor, as well as major, tasks to the best of one's ability. Free yourself of skepticism, mistrust and suspicion. Be ready to be fully prepared, but be patient, bide your time, know how to wait. By all means keep a sharp outlook for opportunities, recognize them and seize them boldly when they come within your reach. But do not think that every change means an opportunity. Stick-to-it-ness of perseverance, of courage to carry on in the face of hope deferred and plans thwarted. Don't think that you can lift yourself by downing others. Throw overboard envy and ill-will. They corrode the things they touch." Young ambitious foremen and inspectors in particular may well profit by following this advice.

Public relations

When out of the shop, the foremen's opportunities are many of taking part in debating public questions and helping to mold public opinion. It is here that he can become the "go-between" the railroad and the general public and enlighten his fellowmen about the many complex problems in regard to transportation.

The work of the foreman who has his company's interest really at heart is never finished. This does not mean that he should neglect his home or private affairs. But, as we are all inter-dependent, and as the foreman plays an indirect part in every branch of transportation, his task cannot end when he leaves the shop. He can help to secure a closer co-operation between railroads and shippers.

The question of government versus private ownership of railroads has at least temporarily been settled by an overwhelming defeat at the last election. Yet it may come up again and every mechanical department foreman should consider it his opportunity to uphold that which by test has proven to be best. Yet as every day of our life is a test day—as each page of a book is a co-related part of the whole—so must the every-day performances of transportation service be a stamp of approval for the continued perpetuation of that service. The foreman can do a great deal to make that service better and better, and to bring about a closer understanding, a unity of purpose and complete co-operation between the owners of the American railroads, the shippers and the general public.

Next to the Bible, the constitution of the United States is still the most important document in existence for us today, and every foreman worthy of the name will consider it a privilege to uphold it.

Don't be a quitter
Whatever you do.
Stand up and fight
'Til you are filled through and through.
With a confidence born
Of a conquering mind,
Let no lack of courage put you behind.
For great men have plodded their rocky trail,
Heeding not that little word called fail.
'Twas onward and onward,
Day after day,
Till they reached success,
The right highway.

N. P. buys ten observation-club cars

Designers have provided unusually complete toilet and lounging facilities—Length over end sills of 77 ft. 3 in.

On April 1, 1926, 10 steel observation-club cars were placed in service by the Northern Pacific on its North Coast Limited trains running between Chicago and Seattle, Wash. These cars were built by the Pullman Car & Manufacturing Company and the first of the cars to be delivered was taken on a month's tour, under the supervision of representatives of the passenger-traffic department of the Northern Pacific, which included 47 eastern and middle western cities. This tour was completed on the return of the car to Chicago on March 20, 1926.

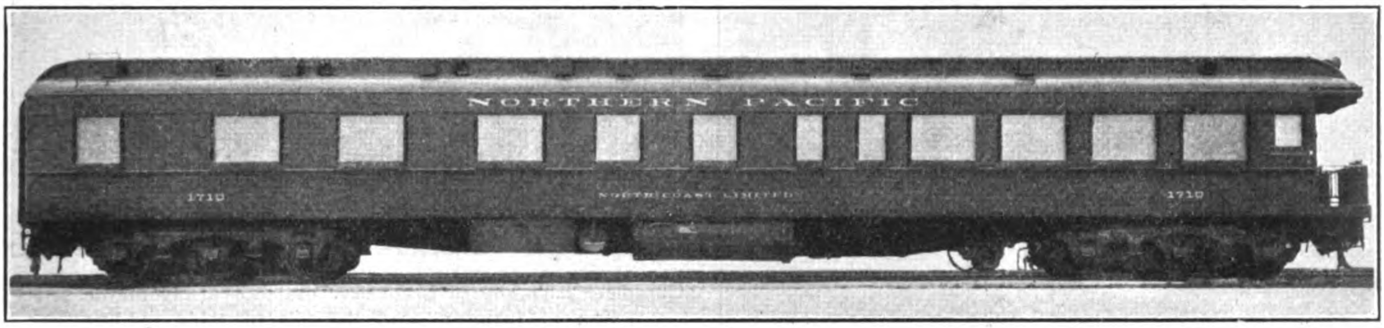
A number of unusual features have been incorporated in the design of these cars. As shown in the floor plan arrangement, the car contains a large observation room, buffet barber shop, a men's toilet, two men's smoking rooms and a women's lounging room. Shower baths are provided for both the men and women.

In order to provide room for these unusually complete toilet and club lounging facilities in a single car, these cars have been built with an overall length of 83 ft. and complete utilization of the possibilities of this length has been effected by building the cars without front vestibules, entrance being gained through the adjoining Pullman cars. Another unusual feature is the elimination of passenger steps and trap doors from the observation platform at the rear of the car in order that there be no interference with the complete use of the observation platform at all times by the passengers on the train.

Interior arrangement and equipment

How the floor space of the car has been utilized is clearly indicated in the floor plan drawing, from which it will be seen that, starting at the forward end of the car, behind the Baker heater compartment, are the ladies' rooms, a single entrance from the corridor communicating with complete shower bath and toilet facilities and a lounging room, the long sofa in which may be made up into a sofa berth. Mirrors are provided in the wall over the lounge sofa and over the dressing table and a full length mirror is placed in the wall between the lounging room and the corridor.

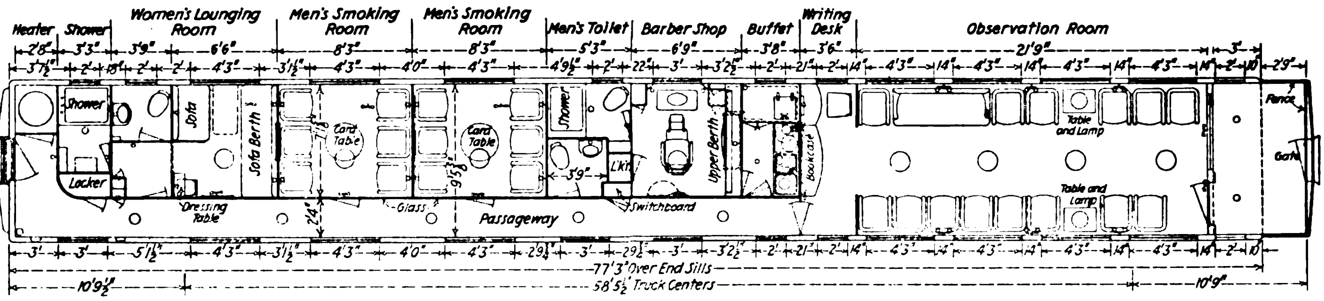
Adjoining the women's rooms are two men's smoking rooms, each equipped with six leather upholstered chairs and a card table. An attractive feature of these rooms is found in the glass panels in the corridor partition on both sides of the doorway into each of these rooms which



The windows of the new Northern Pacific observation-club cars for the North Coast Limited are unusually large—The window at the rear end of the observation room is 4 ft. 2 in. high and 5 ft. wide

enable the occupants to see out of both sides of the car. Adjoining the second smoking room is the men's toilet, accessible from the corridor, and next is a well-appointed barber shop, through which access is had to the men's shower bath. Behind the large mirror in the side of the barber shop opposite the shower bath is an upper in style and finish with the other furnishings and decorations.

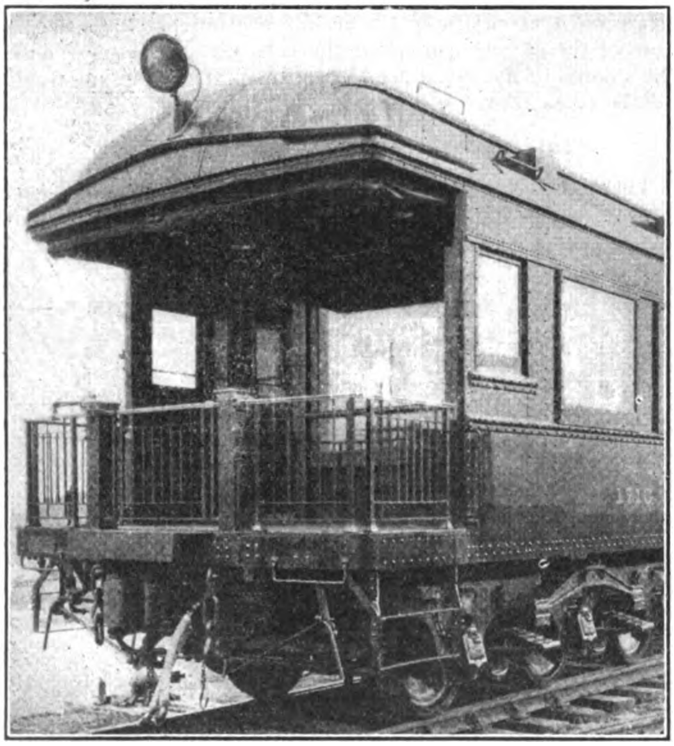
The comfort and general attractiveness of this room is further enhanced by the use of chairs of three distinct types each differing from the others in appearance so markedly that the monotony of the customary



The floor arrangement of the Northern Pacific observation-club car

berth for the use of the attendant. The barber shop and shower are finished in white enamel and the barber shop is completely and conveniently equipped with all necessary fixtures, including a white porcelain pedestal washstand and a full size barber chair. The buffet, which occupies the last compartment adjoining the observation room, is equipped with the essential apparatus for dispensing soda water drinks and other cold beverages and is well supplied with refrigerator and locker space.

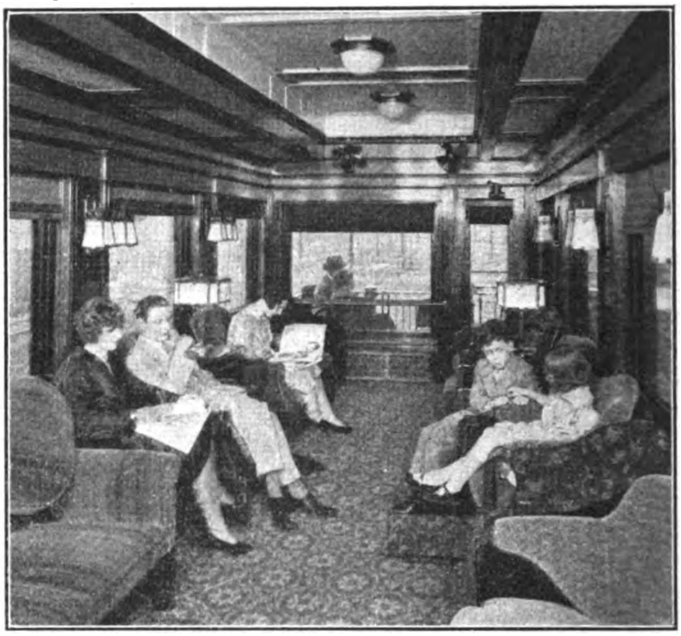
In the observation room which is slightly over 25 ft. in length, there is a marked departure from the conventional type and arrangement of furniture. It will be seen that on either side of the car has been placed a small table and reading lamp and that on one side is a capacious sofa. Across the car from the sofa is a Victor orthophonic phonograph in a cabinet which harmonized



The observation platform is without trap doors, stirrup steps being provided for the trainmen—The searchlight over the hood is for the pleasure of the passengers

rows of chairs in observation and club cars is completely eliminated. The possibility of finding a comfortable seat has also been increased by slight variations in height or tilt of those chairs which otherwise are identical in appearance.

From an inspection of the car, it at once becomes evident that its interior decoration and furnishing was not left to the engineering designer. As the keynote of the decoration of the observation room, the men's smoking rooms and the women's lounging room, the Adam motif was selected and this has been applied to produce a charming effect of harmony and good taste. The interior is finished in French walnut decorated with a color scheme in decalcomania which harmonizes with the soft colors of the carpet specially woven to conform in figure with the prevailing scheme of decoration. The floor consists of a composition top surface laid on a wood base.



Complete harmony of decorative details, variety in the selection of furniture and the use of table reading lamps give character to this observation room

The lighting fixtures were designed and manufactured especially for these cars with ornamentation and coloring in harmony with the Adam motif. The finish on the metal portions of the lighting fixtures is stained brass, accen-

tuated with delicate light colors, including jade, new blue and ox-blood. In addition to ceiling lights and bracket fixtures suitably located throughout the car, the use of well-proportioned table lamps adds materially to the home-like appearance of the observation room. These table-lamps weigh about 60 lb. each and are said to have demonstrated their stability even under severe switching impacts. The car is constructed with a square-decked ceiling finished in ivory-colored agasote, decorated with decalcomania and pencil stripes. Ornate bronze grilles conceal the heating pipes and add a decorative touch to the lower walls.

The windows are of unusually large size

The windows are unusually large, both in height and width, and a person of ordinary height can readily see out of the car while standing erect. The window at the rear end of the observation room is said to be the largest ever used in car construction, measuring 4 ft. 2 in. in height by 5 ft. in width. The windows throughout are of double sash construction and in winter time a third sash is applied to the outside of the car. The shades are of silk-faced pantasote, colored to harmonize with the general scheme.

A floodlighting unit, containing a 250-watt projection type lamp, is mounted on the roof at the rear of the car. Its elevation and direction are controlled by a lever and hand wheel from the observation platform so that passengers can use it at night to view the passing scenery.

These cars, which are 83 ft. in overall length, measure 77 ft. 3 in. over the end sills and weigh 170,500 lb. The trucks, which are spaced 58 ft. 5½ in. between centers, are cast steel of the six-wheel, top equalized type. They are equipped with the Miner safety locking device, Stucki side bearings and Simplex clasp brakes.

The electrical equipment

Five of the 10 cars are equipped with Putnam, 16-cell storage batteries, type CLEF-25 which have a capacity of 360 amp. hrs. The other five cars are equipped with 16 Exide storage batteries, type EP-15, having a capacity of 350 amp. hrs. The axle generators were furnished by the Safety Car Heating & Lighting Company and have a capacity of 4 kw. at 40 volts. They are mounted at the center line of the car and are driven by a 5-in. belt from barrel type axle pulleys. The generator regulators are of the standard Safety type as applied on the general service cars of the Pullman Company. The lamp regulators are the Safety type F of 50-ampere capacity.

These cars are also equipped with the Western Electric Company's desk type telephones which can be brought out of the locker when required and plugged into a jack located at the desk in the observation room. Under the desk is a set box which is wired to a receptacle located over the observation platform to which connection is made at important cities along the line which provides the passenger's telephone service while the train is waiting at these points.

The cars are fitted with the Miner friction draft gear and buffing device, and the Pullman coupler centering and carrying device. Other special equipment of the cars includes Utility ventilators on five of the cars and Mudge ventilators on the other five, with exhaust fan ventilators in the ladies' room and the two men's smoking rooms. The brakes are of the Westinghouse U.C. type with two 14-in. cylinders.

Some fundamentals of the air brake*

A discussion of the braking problems of modern freight and passenger train operation

By Joseph C. McCune
Assistant director of engineering, Westinghouse Air Brake Company, Wilmerding, Pa.

FROM a retardation viewpoint, the most important aspect of the brake rigging is its efficiency in multiplying and transmitting the brake cylinder force to the brake shoes. The losses in the foundation brake rigging are of two descriptions; first, frictional losses and, second, losses due to the angularity between the levers. The frictional losses arise not only at the various pins, but also in connection with the guides and will be as a rule increased with the number of parts of the foundation brake rigging. Since the movable parts of the foundation brake rigging on a modern passenger car weigh approximately two tons, it will be seen that the frictional losses may reach a considerable magnitude with a well designed rigging, the losses due to the angularity of the levers should be small. To bring about appreciable losses from this source, the levers must attain very awkward angles in order that the components acting at right angles will be sensibly diminished from the forces going along the lines of action of the levers themselves.

Foundation brake rigging design

Numerous brake riggings have been constructed, however, which overlook the conditions brought about when shoes and wheels are worn and when brake adjustment has been neglected. Such conditions must be given more careful consideration when the brake rigging is of the single shoe type because with modern brake shoe pressures, single shoes must be located a considerable distance below the wheel center which permits them to travel along the wheel periphery during a brake application and cause more movement of the various levers than may have been contemplated in the design.

To overcome such a condition with others which need not be enumerated here clasp brakes or a rigging which calls for two brake shoes per wheel, has been applied quite generally to modern passenger equipment cars and indeed to an increasing number of locomotive tenders.

The losses in the foundation brake rigging are not well known and actually for running conditions can scarcely be given any quantitative values. The writer knows of only two attempts to measure the mechanical efficiency of foundation brake rigging; one made about 1894 by the late W. H. Marshall, a former president of the American Locomotive Company and, second, during the Pennsylvania-Westinghouse brake tests, above mentioned. Mr. Marshall found that in an emergency application of freight car brakes, only 77 per cent of the calculated pull

* Abstract of paper read before the Eastern New York Section of the American Society of Mechanical Engineers, Schenectady, N. Y., Nov. 20, 1925.

upon each brake beam was actually realized. Some standing experiments were made during the Pennsylvania-Westinghouse tests by means of a hardened ball bearing upon a steel plate. From these experiments it was found that the force transmitted was from 60 per cent to 85 per cent of the force calculated from the pressure acting upon the brake cylinder piston. It has been generally considered that when trains are running the efficiency of the brake rigging is greater than when the train is standing, the vibration causing the members of the brake rigging to move with the development of less friction.

It should be evident, however, that a proper foundation brake rigging is essential if the best braking performance is to be secured. Not only must the brake rigging be of such design that it transmits the brake cylinder force with a minimum loss, but also other factors must be considered if the rigging is not to cause conditions which lower the efficiency of the air brake proper. The foundation brake rigging should be of such construction as to keep the piston travel in the brake cylinder as nearly constant as practicable under all conditions of shoe and wheel wear, etc. Also the brake rigging should distribute the brake cylinder force uniformly, in proportion to the weight braked, to all wheels. A good foundation brake rigging should be designed with such requirements in mind as precaution against accidents due to parts dropping on the track, obtaining minimum brake shoe wear, minimum expense of maintenance, maximum ease of adjustment and provision against improper interchange of parts, etc.

The efficiency of the foundation brake rigging may be controlled to a degree by a satisfactory design. Brake shoe friction on the other hand, can scarcely be controlled although it is obvious that the shoes employed should be of a material which will afford the best coefficient of friction.

Coefficient of friction varies in service

In service, the coefficient of friction varies over a wide range. Exact data as to the variation of the coefficient of friction under service conditions are by no means as extensive as they should be if the coefficient of friction is to be determined for all the varied conditions that may arise in service. Experimental investigations indicate, however, that the coefficient of friction varies with the pressure, the velocity and the time the brake shoe has been rubbing against the car wheel. The exact variation of the coefficient of friction with pressure is not known but all indications point to a reduction in the coefficient of friction as the pressure is increased. Such a relationship would be contrary to the results found in early experiments when slow moving bodies were considered. It should be mentioned that the action at high velocities is quite different from that existing at very low velocities.

The coefficient of friction decreases with the velocity. The curve showing the relation of velocity to the coefficient of friction appears to be a rectangular hyperbola. Having such a curve in mind, it will be readily appreciated that as the velocity reduces the coefficient of friction approaches a constant value and more and more slowly as zero velocity is reached. On the other hand, as the velocity increases, the coefficient of friction approaches some value which will never be zero, but is always some finite value even with an indefinite increase in velocity. Unfortunately, however, the rapid change in the coefficient of friction takes place during the range of velocities that are encountered in service.

The variation in friction with velocity has been expressed by the formula $F = \dfrac{.326}{1 + .035\,V}$. Such a formula gives a coefficient of friction at 60 miles an hour of .105 and at five miles per hour of .277. Since the retarding force is directly proportional to the coefficient of friction, the retarding force at five miles per hour would be almost three times the retarding force at 60 miles per hour. It should be stated, however, that this formula shows the variation in the coefficient of friction for velocity only and does not consider the pressure or the time of rubbing, both of which factors are present in service and which modify the value of the coefficient so that the formula above has no practical utility.

The decline in the coefficient of friction, due to continued rubbing, appears to be caused by the work done upon the shoe and is presumably some function of the work done. The decline due to continued rubbing is of practical importance because it has been found that an increase in pressure on the brake shoe does not bring the reduction in stopping distance that would be expected if the coefficient of friction were independent of the amount of work done upon the brake shoe. As has been mentioned, during the extensive Pennsylvania-Westinghouse brake tests, made near Atlantic City, N. J., in 1913, it was found that for an increase of five per cent in the brake shoe pressure, the stopping distance was decreased by about two per cent. Such a relationship held for the range of pressures used during these particular tests but might not apply for a wider range of pressures.

This decrease in the coefficient of friction with the amount of work done upon the brake shoe, explains why it is much more difficult to stop the modern train in a given distance than was the case many years ago. Indeed, the most elaborate brake equipment of the present day does not bring about a stop in a distance much less than was required many years ago with simpler air brake equipment and foundation brake rigging of a much lower degree of refinement. The increase in train speeds greatly increased the work done by the brake shoe since the energy to be absorbed by the shoes varies as the square of the velocity. Increase in car weight also increased the work to be done by the brake shoe so that much higher brake shoe pressures are required to produce the same stop distance that was secured when velocities and car weights were less.

It will also be noted that the variation in the coefficient of friction is contrary to what is desired in a brake shoe. To produce a short stop, the retarding force should be greatest when the velocity is highest. If the retardation is made high when the velocity is high through the application of very heavy shoe pressures, then the retardation becomes so great when the velocities are low as to cause the wheels to slide. Stops in actual service, therefore, are much longer than would be the case if the retardation existing toward the end of the stop could be obtained toward the commencement of the stop.

The thought will probably occur that such a condition could be met by applying a very heavy shoe pressure at the beginning of the stop and gradually diminishing this pressure as the stop proceeded with a consequent increase in the coefficient of friction. Actually, however, such an arrangement presents practical difficulties in the way of reducing the pressure for the many varied conditions that are found in actual service. Moreover, the pressures which would have to be applied toward the beginning of the stop are extremely high. It is the practice with modern passenger equipment cars to apply to the brake shoes during emergency brake applications, a pressure which is 150 per cent of the empty car weight before taking into account any losses in its transmission from the brake cylinder. As the modern dining car will weigh about 75 tons, such a car will have during an emergency application, a total nominal brake shoe pressure of 105-

tons. If this pressure is to be much augmented, it will be evident that either the brake cylinder piston area will have to be increased or that the pressure exerted in the brake cylinder will have to be much beyond that now used. Either method would present very great practical difficulties with equipment as it now exists.

Air brake equipment possesses many different characteristics depending upon the type of vehicle, the kind of service and other operating conditions of this same character. Many of the functions are common, however, to all equipment. For this reason, the different functions in common use will be examined with some comment as to the reasons for their existence.

Steps in the development of the air brake

Tests made by the M. C. B. Association on the Chicago, Burlington & Quincy in 1886 indicated conclusively that improvements in air brakes were necessary to meet the changed conditions since the invention of the first plain triple valve. Obviously, with a plain triple valve, the brake on the first car applies first, the brake on the second car, second, and so on, in order. With an emergency application the shock resulting was extreme even with the light weight cars used in 1886.

To meet the need for a greater rapidity of brake application, the quick action triple valve was invented. This triple valve consisted of the plain triple valve with an additional piston and valve. With this triple valve, whenever the brake pipe reduction was accomplished at an emergency rate or at a rate much in excess of that used in service, this additional valve was opened so as to connect the brake pipe to the brake cylinder. On account of these numerous passages through which brake pipe pressures could be reduced, the brake pipe reduction was accomplished in much less time than had theretofore been the case and in addition, with a greater uniformity throughout the train. With the quick action triple valve, it is possible to pass a brake application throughout a train at the rate of about 600 ft. per second. When it is considered that this rate is about one-half the velocity of sound it will be appreciated that the quick action triple applies the brakes throughout a long train with a rapidity which does not leave a great deal to be desired.

The quick action triple met the needs of service for a number of years. The next improvement in brake equipment was also in the direction of greater flexibility. The brake valves up to the time considered, had been simple forms of cocks with which the brake pipe was opened directly to the atmosphere when a brake application was wanted. It was found with long trains, that if the brake pipe was quickly opened to atmosphere and then as quickly cut off from atmosphere, a surge in the brake pipe pressure resulted which would cause the head brakes to release on account of the rush of air toward the head end of the train setting up a pressure sufficient to bring about a release. To overcome this condition, the equalizing piston was invented. With the equalizing piston goes an equalizing reservoir which is normally charged to brake pipe pressure. Pressure from the equalizing reservoir acts upon the top of the equalizing piston. The other side of the equalizing piston is open to the brake pipe and carries a stem which is normally held against its atmospheric seat. With a reduction in equalizing reservoir pressure, the equalizing piston lifts and permits brake pipe air to escape to atmosphere. The lift of the equalizing piston is a function of the train length. The opening between the brake pipe and the atmosphere is thus adjusted to the train length and moreover this opening is made or closed gradually so that objectionable surges and waves are not set up in the brake pipe.

The effectiveness of the brake was sufficient for service requirements until the early 90's when passenger trains were operated at higher speeds than had up to this time been used and the stopping distance was consequently increased. The effectiveness of the brake at this time was bettered by raising the brake pipe pressure from the 70 lb. which had been used, up to the 90 lb. or 110 lb., characteristic of present day service. As a result, the pressure obtainable in the brake cylinder was increased some 70 per cent. If this pressure were held continuously during an emergency stop, with the light equipment used at the time, the wheels were apt to slide toward the end of the stop on account of the increase in the coefficient of friction. To prevent such wheel sliding a high speed reducing valve was added to the equipment, the function of which was to reduce the brake cylinder pressure as the stop proceeded.

Latter developments in air brake design

With the functions that have so far been discussed, the brake equipment satisfactorily met service conditions for a period up to the beginning of the present century. Then the need for both greater flexibility and effectiveness became apparent. The addition of the quick action function improved the rapidity with which an emergency application throughout the train could be secured but did nothing toward increasing the rapidity of a service application. As train lengths increased, particularly with freight trains, the delay in securing a brake application became very objectionable. To hasten the brake application throughout the train and to make it more uniform, triple valves were changed so as to include a function known as the quick service function. This is similar to the quick action function except that it is utilized only during a service application and the quick action function only during an emergency application. When triple valves take up the quick service position, communication is made on each car between the brake pipe and the brake cylinder. Consequently, the brake pipe pressure is reduced more rapidly and more uniformly than would be the case if the reduction had to be accomplished by all of the air escaping from the engineman's brake valve. The quick service function is needed for present day conditions and is included or can be included with all modern equipment. As indicating the rapidity of brake application brought about by the quick service function, it may be noted that tests made on the Virginian Railway in 1920 showed that a service application throughout a long freight train could be brought about at the rate of 294 ft. per sec. or approximately one-half the emergency rate.

Difficulties encountered in braking long freight trains

Long freight trains had shown the need, not only for a function which would apply the brakes more rapidly and more uniformly, but also for a function which would cause a more uniform release. The pressure in the brake pipe is controlled by the engineman so that when it is desired to increase the brake pipe pressure, pipe friction causes a higher pressure to be built up at the head end of a train than at the rear. Consequently, the brakes at the head end of a train release before those at the rear. If the head cars are permitted to run with only a partial brake and the cars at the rear are being retarded with a more effective brake, the cars at the rear will tend to pull away from those at the head and under some conditions the stresses set up may be sufficient to cause the train to part.

Advantage was taken of the fact that the pressures at the head end of the train are higher than those at the rear during release. The triple valve was so modified that this higher pressure could be utilized to force the

triple to what is known as retarded release position. In this position the release of brake cylinder pressure is through a restricted opening so that the release throughout the train is substantially uniform.

This high pressure at the head end of the train also gave difficulty in that the auxiliary reservoirs at the head end were overcharged as compared with those at the rear. In order to restore the brake pipe pressure promptly with a long train, the release position of the brake valve permits main reservoir pressure to pass directly to the brake pipe. Since the main reservoir pressure is higher than the normal brake pipe pressure, the brakes at the head end of the train would reapply when the brake pipe pressure had reduced to normal. Such a condition was overcome by designing the triple valve so that when it took up retarded release position, the charging of the reservoirs was accomplished through a restricted port. The charging of the head reservoirs was, therefore, at a lower rate than obtained for the reservoirs at the rear. As a consequence, the charging of the reservoirs throughout the train was made substantially uniform.

These two functions of retarded release and retarded recharge apply to freight equipments but are not required with passenger equipments because passenger trains are shorter than freight trains. The quick service and quick action functions apply, however, to both passenger and freight car service.

Increasing passenger car weights and speeds require more efficient brakes

As train weights became greater, difficulty was encountered in holding down the emergency stopping distance. An increase in car weights decreased the coefficient of friction which in turn increased the stop distance. It was found that the work done upon the brake shoe was so great that the increase in the coefficient of friction with decrease in speed was not sufficient to cause objectionable wheel sliding toward the end of the stop. As a result passenger triples were so designed that a high emergency cylinder pressure was obtainable and this pressure was held throughout the stop without reduction. The service cylinder pressure was limited by a safety valve but this safety valve was cut off during an emergency application. To secure the high emergency cylinder pressure, an additional reservoir known as the supplementary reservoir was added to the car brake equipment. From a normal brake pipe pressure of 110 lb., it was possible to secure an emergency cylinder pressure of 100 lb. This higher emergency cylinder pressure made it possible to keep the emergency stopping distance down to the values which had existed with lighter cars.

Increasing severity of service operations also indicated the need for more flexible brake operation with respect to the release. With the early forms of triple valves it was not possible to make a partial release of the brakes. Addition of the supplementary reservoir made it possible to add the graduated release function. This function was accomplished because the supplementary reservoir was not drawn upon during a service application and its pressure, therefore, could be made to return the triple piston toward service position when this was desired.

Improvements in triple valve operation

Increasing difficulty was encountered in keeping down the emergency stopping distance as car weights became greater. To meet this need, control and universal valves were designed. The universal valve is now included in standard passenger car brake equipment. It differs radically from the earlier forms of triple valves in that separate parts are provided for service applications and emergency applications. With the earlier forms of triple valves, they might take up emergency position when only service position was intended. To prevent such an occurrence, the universal valve was designed with the service and emergency elements entirely separate so that the action of one would not affect the action of the other. In order to secure the effectiveness wanted, the emergency portion was designed with large ports and passages and with parts so constructed that the emergency cylinder pressure could be realized in the very shortest time. With the universal valve, a pressure of 100 lb. in the brake cylinder can be developed from 110 lb. brake pipe pressure in approximately two seconds. With the earlier forms of triple valves, it had not been possible to secure the quick action function if a service application had been made immediately before quick action was wanted. The universal valve differs from these earlier triple valves in that it is possible to secure quick action and high emergency cylinder pressure at any time regardless of whether a service application has previously been made.

The locomotive brake equipment

When service conditions were less exacting, the locomotive brake equipment was essentially a car equipment with apparatus super-imposed for providing compressed air and giving control of it to the engineman. To meet the requirements of improved service, however, an equipment was designed which provided for a more complete control of the locomotive brakes, either independently or in conjunction with the train brakes as desired. Instead of a triple valve, a distributing valve was employed.

The distributing valve acts in a manner corresponding to the plain triple valve to develop pressure in a cylinder in accordance with the intention of the engineman. A piston in this cylinder allows main reservoir air to pass to the brake cylinders and build up in them a pressure corresponding to that existing in the distributing valve cylinder. With such an arrangement the same distributing valve can be used for all classes of locomotives, regardless of their weight. Moreover, space is conserved because auxiliary reservoirs are not required since the brake cylinder air is secured directly from the main reservoirs. The distributing valve does not require in itself the quick action or quick service functions because it is located on the locomotive. The distributing valve does, however, have the function of high emergency cylinder pressure so that the emergency stop distance of the train may be made as short as possible.

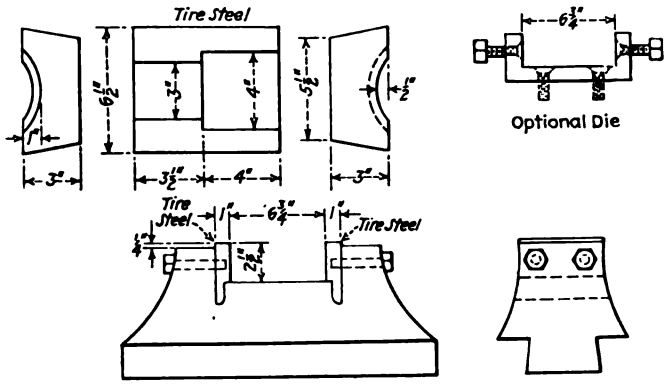
One difficulty in recent years has been the insuring of quick action passing throughout a train. When locomotives were smaller than is the case today, movement of the engineman's brake valve to emergency position developed a reduction in brake pipe pressure on the first car at an emergency rate. As the distance between the engineman's brake valve and the air actuated device on the first car increased, it became more difficult to secure an emergency rate of reduction on the first car, which was needed in order to start quick action functioning on the train. To overcome this condition, a vent valve was added to the locomotive equipment. This vent valve is an intermediate device which acts as a relay to insure that the rate of reduction on the first car will be an emergency rate whenever the brake value is placed in emergency operating position.

Air brake equipment for electric locomotives

The foregoing comments have applied in greater or less degree to all air brake equipments. To meet special operating conditions, many air brake equipments have been devised which have incorporated in them functions quite different from those that have been discussed.

Coupler repairs—Shop made pneumatic press

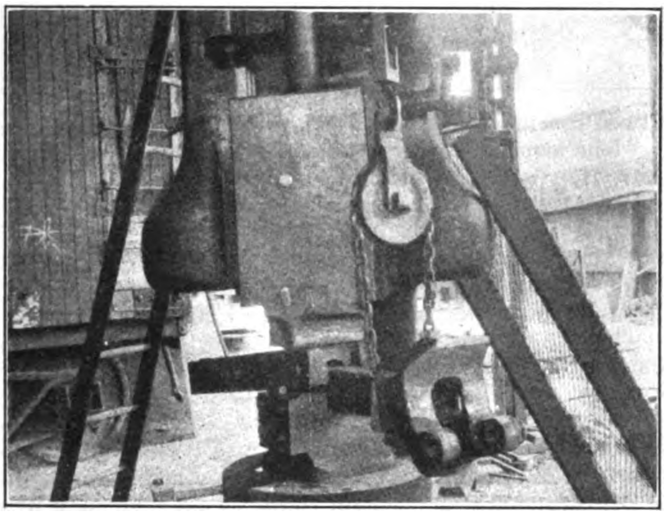
COUPLER repair work at large car shops and even at some of those of medium or small output forms one important detail of the total work of overhauling freight and passenger cars and conditioning them for further service. It is obvious that the best results are secured where the coupler work for a railroad system is concentrated at a relatively few points having properly



Dies for shearing coupler rivets under a 1500-lb. steam hammer —Optional die gives less difficulty from working loose under hammer blows

trained men and equipment for the most efficient handling of the work. From a safety standpoint and that of possible delays to service, couplers are one of the most important of car parts and they must be maintained in accordance with prescribed standards found by experience to reduce to a minimum the possibility of rapid wear, or failure.

Some of the equipment for handling coupler repair work at one of the largest car shops in the Southwest is

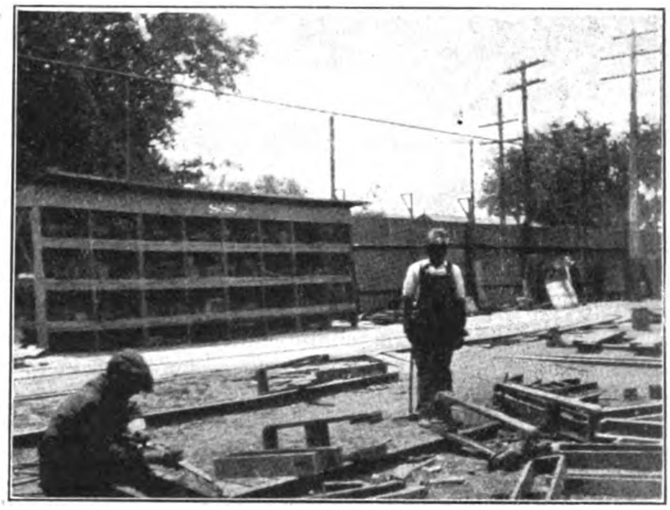


Operation of shearing coupler rivets under 1500-lb. Morgan steam hammer equipped with special dies—guard protects hammer operator

shown in the illustration. Approximately 850 couplers per month are overhauled at this point, being mostly of the American Railway Association standard "D" type. The couplers consist of coupler body, draft yoke and vertical thimble, assembled with three $1\frac{1}{4}$-in. rivets in the case of the lighter couplers and four rivets for the heavier ones. These couplers are stripped, usable parts reclaimed, annealed, re-assembled and riveted, then being ready for application to the cars on the outbound track.

The stripping operation consists of placing the coupler on a special die under the Morgan 1500-lb. steam hammer illustrated, the rivets being sheared and the coupler body separated from the draft yoke usually by a single blow of the hammer. A differential chain hoist suspended from a jib crane above the hammer supports the outer end of the coupler while the rivets are being sheared and enables the coupler to be handled with a minimum of physical effort. It will be noted from the illustration that a guard serves to protect the hammer operator from possible injury due to flying rivet heads. Referring to the drawing, the construction of the hammer dies will be evident. Under the action of the hammer the top die forces the coupler into the recess in the bottom die, securely keyed to the hammer base, shearing the holding rivets at a single blow. This work is handled by one hammer operator and two helpers, the production averaging about 20 couplers stripped per hour.

To remove the vertical thimbles the heads of the holding rivets are cut off by the oxy-acetylene cutting torch and the rivet bodies backed out with a handle punch and



Station where coupler thimble rivet heads are cut off with a torch and rivets backed out with a handle punch and sledge

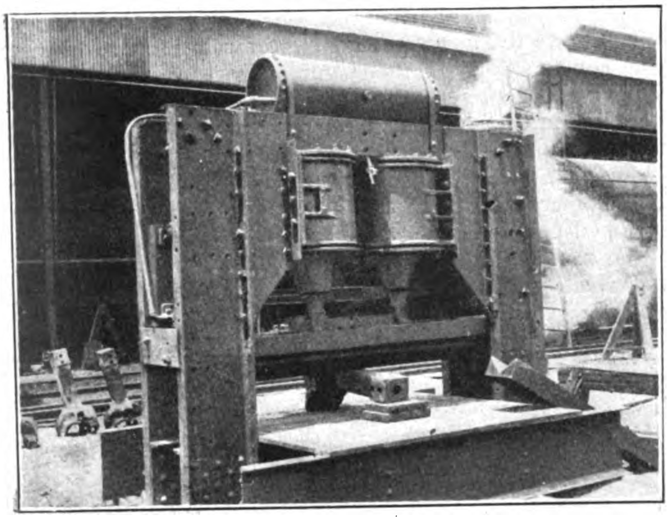
sledge hammer in the hands of helpers. The reason for this is that the vertical thimbles are of malleable iron and would not, in the majority of cases, stand a blow sufficient to shear the rivets under the steam hammer. Following the stripping operation, the rivet heads are punched out of the yoke and broken pieces of the rivets from the coupler shanks. It will be noted from another of the illustrations that two rails set in the ground serve as a convenient and substantial support for couplers while rivets are being backed out.

When not too badly worn, coupler shanks, knuckle and lock pin bearing surfaces are built up by electric welding. When bent, the coupler shanks are straightened hot under the pneumatic press illustrated, the couplers then being carefully annealed, reassembled with a new yoke and thimble when needed, and riveted in a 70-ton Hanna pneumatic riveting machine, also used for riveting draft lugs on sill splices and other similar work. The arrangement of the equipment for assembling couplers is such as to minimize the labor of handling and enable the maximum output to be obtained. The couplers are readily handled to the riveting machine by two men, and a special forge capable of heating 35 of the big rivets at a time assures an adequate supply of rivets when needed. Coke

reclaimed from the blacksmith fires is used in the furnace.

The average cost of reclaiming couplers at this point is $2.33 apiece, including the labor of stripping, handling to and from the welders and in and out of the annealing furnaces, and the cost of the oxy-acetylene gas cutting torch and operator. Draft yokes are reclaimed at an average total cost of $1.34 apiece.

The pneumatic press, shown in one of the illustrations straightening a coupler shank, has proved very valuable at this car repair point for forming sill splice patches; straightening truck sides without heating by the use of oak blocking with a straight edge and gage; straightening coupler shanks hot; straightening angles cold, using top and bottom V-blocks; and many other operations in connection with steel car repair work. It is said to be economical in the use of air, being usually operated when air consumption in other parts of the shop is not heavy.



Shop made pneumatic press designed to be economical in the use of air and provide pressures up to 22 tons with 90-lb. air pressure

Reclaimed couplers ready for the application of knuckles, knuckle pins and locking mechanism

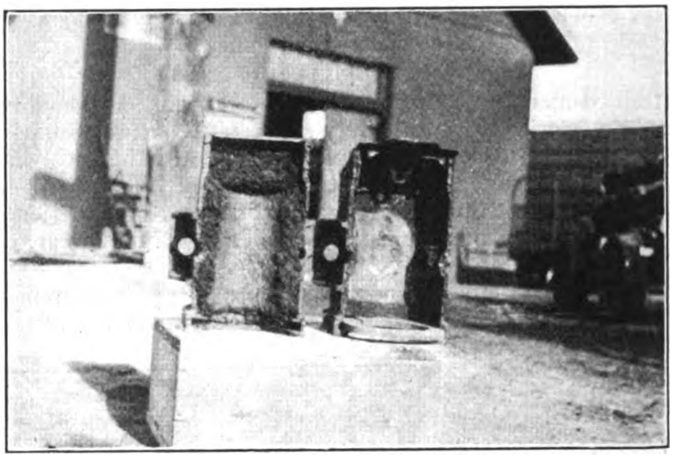
This pneumatic press is made entirely from scrap steel car parts. It is built up of angles and 15-in. channels supporting two 18-in. passenger car air brake cylinders which operate the equalizer and V-block. The piping arrangement is such that the pressure between the cylinders is equalized and the pistons move downward together. A distance of 5 ft. 8 in. is provided between the columns, there being a working space of 10 in. under the V-block and 17 in. under the equalizer. The bed plate, 15/16 in. thick, is rigidly supported, as shown on two heavy channels. Two small 6-in. air brake cylinders, not shown in the illustration, serve to raise the equalizer and V-block. To secure economy in air consumption, air exhausted from the 18-in. cylinders into the reservoir on top of the press frame is used in these small lifting cylinders. As a safety feature, a by-pass in the piping provides for the admission of air direct from the main pipe line to the 6-in. cylinders when changing dies. With 90 lb. air pressure, 22 tons is developed in this shop made press.

Condition of packing in a test journal box

By G. H. Fahrenbruck

General car foreman, C. B. & Q., Sheridan, Wy.

HOT journal boxes in freight service are common to all railroads. Many methods have been devised with more or less success in an effort to determine just what actually takes place in a journal box while in service. In an effort to obtain a true picture of the conditions, a standard 5½-in. by 10-in. journal box was cut in half and applied to journal L4 on an arch bar truck under a 100,000-lb. capacity steel gondola car used in coal service. The box was applied and sealed September 26, 1925, and ran for a period of four months or to January 26, 1926, without receiving any attention at terminals or by train crews. During the test the car ran 1,200 miles.



Glazed condition of a journal box packing in a test box after four months' service without receiving any attention

The accompanying illustration shows the condition of the box when removed from the journal. It was found that the top of the packing for the full length of the journal was glazed and dry. All the oil was in the packing and none in the bottom of the box. The glazed condition of the packing prevented capillary attraction of the oil to the journal and would have caused a hot box in a short time.

These conditions emphasized the importance of loosening up the packing at important inspection terminals and adding a little free oil which would be a step in the right direction of reducing hot boxes. However, if free oil is not used more often, then it would be well to consider the repacking of journal boxes at more frequent intervals than is now the practice. The reason for this suggestion is that old packing glazes over quickly and reworking the packing will do little or no good without pulling out the packing and repacking the box.

The car inspector and freight claim prevention*

Proper investigation by qualified employees would aid in fixing responsibility for damage

By W. R. Rogers

Chief interchange inspector, Youngstown, Ohio

THE proper loading, bracing and blocking of cars, both closed and open top, is a very important matter and to my mind it is just as essential for us to know that the cars are braced and blocked in accordance with the American Railway Association Code of Loading Rules as it is to know that there are no defective wheels under the car. It may not be absolutely necessary that the division car foremen, general car foremen and other mechanical supervisors know in detail the various rules covering the bracing and blocking of the various commodities that are transported by the railroads to all parts of the country, but I do feel that these supervisors should at least know the Loading Rule requirements for shipments originating in territories over which they have jurisdiction. Otherwise, how can the supervisors properly instruct the inspectors in matters pertaining to the loading of commodities that require special staking and blocking?

Loading Rules are not adopted without good and sufficient cause and then only after many experimental trial shipments have proved the feasibility of such loading. Many of the large shippers have had a great deal to do with formulating a number of the present rules and I have heard railroad officers make the remark that many of the shippers know more about proper bracing and blocking their shipments than we do. That statement is the truth but it is not the whole truth. Would it not have been better to have said, "Many shippers know more about the proper bracing and blocking of their commodities than some railroad men do." Do not misconstrue this statement to mean that some of the shippers do not know as much as the best of us know about proper loading, bracing and blocking their material, for such is not the thought. I just want to bring out that some of us know so little about the Loading Rule requirements that some shippers have it "all over us," so to speak, when it comes to proper bracing and blocking.

The carriers pay out annually enormous sums of money for loss and damage due to a variety of causes. Speaking of just two of these—rough handling and improper loading—who can say how much of the money paid out in loss and damage claims that are charged to rough handling should, if the truth were known, be charged to improper loading? And who can say how much of the amount is charged erroneously to improper loading? We have a number of special representatives, special agents, inspectors of depots and board walks, inspectors of this, that and the other; every one of them good fellows, with the very best of intentions conducting investigations and making reports based on their investigations and charging the amount of the claims to some cause other than the real cause. In order to make myself clear, I would just like to mention a few of the reasons given for certain loss and damage.

Recently I had some claim papers where the agent at destination stated that 16 sections of wrought iron pipe, which was a part of a possible two hundred sections in the car, were bent on account of being loaded in a car too long for the pipe. Can you imagine what the length of the car would have to do with the bending of that pipe?

In another case, the temporary side stakes broke on pipe shipments causing the pipe to spill off along the right-of-way. The person originating the report and giving the cause for the stakes breaking and the pipe falling off, stated that it was due to the fact that the stakes were placed on the inside against the car sides instead of in the stake pockets. Any person at all familiar with the loading of pipe knows that, when the stakes are placed in the stake pockets and wire is used to tie the opposite stakes together, which is the rule requirement, when the pipe shifts, as it invariably does, the stakes are very apt to snap off; whereas, if they are not placed in the stake pockets but placed on the inside of the car as permitted in the Rules, that dangerous condition is eliminated.

In another case a large scrap iron dealer loading a car load of sheet steel presented a claim for a large sum of money on account of rusted sheets. Where is the yardmaster that would furnish a scrap iron dealer a water proof car, or in other words a car fit for sheet steel, unless he had a special request for such a car?

Just one more case that I wish to make mention of—the president of a sheet manufacturing plant got in touch with the general freight office saying in part that the car inspector was tying up their shipments, refusing to accept them because they were not braced and blocked in accordance with some rules the car inspector had, and that the carrier's agent had expressed an opinion that the load was well braced and would no doubt protect the sheets to destination. I was asked to investigate and I called upon the agent, had him go with me to the car and open it up. I found in the first place that the car was unfit for high class sheet steel subject to damage if it became wet, because it was in a leaking condition. You could see daylight through it in several different places. The sheet steel in the car was rusted and the edges were bent. We are paying claims every day for such damage but in this case they were in that condition when placed in the car; the shipper acknowledged it. I asked the agent if the shipper was given a clear bill-of-lading and he said he did not know; that he would get the bill of lading and see. He came back with the information that the shipper had been given a clear bill-of-lading but he would make notation as to the real condition. There was nothing to prevent the consignee receiving the sheet steel from entering a claim for rusted and bent sheets, if he so desired, and the carrier could not produce an inspection record that the car was fit for sheet steel. Furthermore, the shipper had a clear bill-of-lading.

How much of this large amount is charged to improper

*Abstract of a paper presented before the Cleveland Steam Railway Club on March 1, 1926.

loading and defective equipment that the railroads are in no way responsible for? The president of the above referred to sheet manufacturing plant expressed a willingness to load in accordance with the Rules. I gave them the car inspector's Loading Rule book and the agent, car inspector and myself went into a car they were loading and I asked the agent for his Loading Rule Book, so I could show the men doing the bracing just how to install it. The agent handed me his rule book and I turned the pages over to the Sheet Rules. For a moment I thought I must be dreaming until I looked at the cover of the book and found that it was an issue of 1922 and the method of loading sheet steel has since been materially changed. The agent said that was the only book he had. How could that agent make a proper investigation at destination and say whether or not loads were properly braced and blocked when he did not have an up-to-date Loading Rule Book?

Consignees many times, upon the arrival of freight in a damaged condition on their sidings and unloading tracks, call upon the agent or a freight claim adjuster to make an inspection; possibly the agent himself makes the inspection. Does he know whether the car was originally improperly loaded or not? Does he know what the rules require; if he does not know, how can he make a proper statement as to the probable cause of the damage? Does the freight claim adjuster know the Loading Rule Requirements? How many thousands of dollars are charged to improper loading on reports furnished by employees who do not, in some instances, know that we have a Loading Rules Book? If the freight claim division of the American Railway Association were to insist that the freight agent at destination call upon a qualified mechanical representative to make an inspection and ascertain whether or not shipment was properly braced and blocked in accordance with the Loading Rules, would it help any toward getting at the true facts and placing the responsibility where it properly belongs? Would such action not permit an intelligent report of the true conditions with the possibility of correcting the condition at the originating point of loading and prevent some of this damage that goes on from day to day because the true facts and conditions are not developed?

I could go on for hours and recall cases where reports have been made giving reasons for loss and damage as "improperly braced and blocked," but I believe the few cases mentioned will convince anyone that proper investigations by employees who are fully qualified by their knowledge of the Loading Rules requirements is desired and necessary in order that the causes for loss and damage may be properly developed and the responsibility and cost be put where it properly belongs.

Improper bills and wrong interpretations*

By M. S. Belk

General air brake instructor, Southern Railway, Washington, D. C.

I RECENTLY read some correspondence relating to five different bills for air brake work performed, concerning which 55 letters had been written. In no case did I consider any of the bills to be just, or in accordance with A. R. A. Rules, and they were ordered to be cancelled. If the files of all the railroads should be gone over, there is no doubt in my mind but that a large number of like cases would be found. It costs money to make out bills, it costs money to write letters, and when either is done unnecessarily, it properly comes under the head of "unnecessary expenses."

A foreign car brake on your repair track is cleaned, lubricated, tested and stencilled strictly in accordance with A. R. A. rules governing this work. A few days or a week thereafter, this car is on another road and an excessive leak has developed at the triple exhaust. The inspector considers the defects of sufficient importance to justify changing the triple. If he does, you know that in order to justify the charge, the work must be performed according to Rule 60. Even if this is not so, many roads will want to use the bill of the second road as joint evidence to show that the work was not properly performed by your road.

Men who are at all versed in the air brake art know, regardless of how well you may condition a triple valve that there are a number of disorders which are liable to occur at any moment after the valve is placed in service. Some of these disorders are leaky slide or emergency valves, leaky piston packing rings and excessive friction. We have every reason to believe that the triple valve manufacturers turn out new valves in as near 100 per cent condition as it is possible to put them, still we find many new valves which develop one or more of these disorders almost immediately after being placed in service; in fact, many become defective while being shipped. I am sure that you will agree with me, if I have stated the facts, that correspondence about such cases should come under the head of "unnecessary expense."

There are a large number of cases written about and concerning which joint evidence is taken of poor or improper workmanship, which consume time, and time in the major portion of cases means money expended. While I do not agree that it is altogether right, still it is my understanding of the A. R. A. Rules that there is only one ground upon which we may submit joint evidence and expect a bill to be cancelled, namely, "wrong repairs," except failure properly to obliterate the old stencilling in case of a second cleaning by the same road before the car reaches home. Submitting joint evidence about poor or improper workmanship so far as I know is not worth the card it is written on, much less the time it requires to procure it, so, in my opinion, this also comes under the head of unnecessary expense.

Considerable unnecessary correspondence between many roads, is caused by the many different interpretations being placed on the rule requiring the individual test of a brake after cleaning. Some understand this rule to mean that a car must be on a repair track where you have yard air pressure and the individual test made. If you have and use the proper single car testing device, and the brake is cleaned in accordance with Rule 60 the car could be placed anywhere in a 100-car train. With the proper testing device attached to the hose at the front of the car we have cleaned, and with the rear angle cock open but the cock closed on the next car in the train, charge the brake system fully to standard pressure, close the angle cock at the rear of the car immediately in front of the one cleaned and you can make just as accurate an individual test as if the car were on the repair track. What does it matter if the air comes from a yard compressor through a yard air line or from a locomotive compressor through the brake pipe of several cars? If I am correct in my interpretation, then why should not all this correspondence about how the individual test is made, come under the head of unnecessary expense?

I am advised of considerable correspondence about "in-date" brake cars on repair tracks for other repairs for which there is no labor charge. The brake is cleaned because the stencilled date is 10 months old. The owner asks for cancellation of the brake cleaning bill because no

*Abstract of a paper read at the January 16, 1926, meeting of the Southeastern Air Brake Club, Atlanta, Georgia.

other bill is submitted. All of us know, even if there are no labor charges, that if we shop a car for such repairs we must submit a bill and mark it "no bill." This will show that the car was not shopped exclusively for air brake cleaning. Every car when shopped for repairs should be given a thorough and proper air brake test, regardless of the last date of cleaning. If either the triple or cylinder is defective, we may clean them and charge for the work, unless the brake is cleaned by the same road within 60 days. In such cases, I would say remedy the defect and mark the bill "no bill."

If we try to interpret the rules so as to make them fit our own case just to justify a charge and later receive a like bill and refuse to accept it, we are not living up to the principle and intent of the American Railway Association Rules.

Annual inspection report of safety appliances

THE report of the Director of the Bureau of Safety to the Interstate Commerce Commission for the fiscal year ending June 30, 1925, shows that during the year a total of 1,167,980 freight cars were inspected, of which 40,662, or 3.48 per cent, had defective safety appliances, a total of 50,395 defects being reported. There were 22,526 passenger cars inspected, of which 268, or 1.19 per cent, were found with defective safety appliances, a total of 514 defects being reported. A total of 23,664 locomotives were inspected, of which 496, or 2.1 per cent, had defective safety appliances, 664 defects being reported. The number of defects per thousand cars and locomotives inspected was 42.46 as compared with 52.73 for the preceding fiscal year. These figures are the totals of Table I shown in the report.

This table contains a list of the defective appliances on freight and passenger cars and locomotives reported by inspectors during the fiscal year, 1925. A summary of the more common defects listed in the table follows:

Couplers—A total of 2,835 coupler defects were reported. the most important groups of which were 1,601 worn bodies, 573 low couplers and 239 loose carrier arms. Only 127 broken coupler bodies were reported.

Knuckles—A total of 3,687 knuckle defects were reported of which 1,406 were worn knuckles, 1,073 worn knuckle pins, and 912 broken knuckle pins. A total of 93 broken knuckles were reported.

Lock blocks—A total of 5,222 lock block defects were reported which consisted principally of 1,519 worn lock blocks, 1,151 inoperative, 907 with the lock lift disconnected or missing and 305 lock lifts bent or broken.

Uncoupling mechanism—A total of 4,015 uncoupling mechanism defects were reported of which 379 uncoupling levers were bent, 513 wrong or incorrectly applied, 356 disconnected, 559 inoperative, 425 handles too low and 1,192 uncoupling chains broken.

End locks—The inspectors found 145 defective end locks.

Keepers—A total of 241 keepers were found defective, of which 169 were loose keepers.

Visible parts of the air brake—The inspectors found 18,839 defective visible parts of air brakes of which 3,995

Causes of instances in which train-service employees remained on duty longer than 16 consecutive hours for the past five years.

Causes	1921	1922	1923	1924	1925
Collisions	1,336	322	889	584	439
Derailments	15,066	5,670	9,203	7,533	4,557
Track defects and obstructions	704	224	391	299	142
Landslides, high water, fire	1,218	552	633	560	1,221
Adverse weather conditions	2,283	2,096	3,299	2,154	2,715
Congestion of traffic	1,048	325	1,071	402	670
Station work, waiting for orders and meeting trains	1,766	532	1,373	594	586
Coupler and drawbar defects	5,289	1,890	3,760	1,881	1,313
Miscellaneous car defects	4,527	1,405	2,939	1,473	805
Hot boxes	221	54	246	114	109
Air troubles	1,524	480	1,301	632	403
Taking or running for water	247	170	289	203	124
Cleaning fires	31	15	32	0	2
Low steam:					
Poor coal	206	26	94	27	21
Bad water	0	0	0	4	22
Leaking	424	97	640	134	41
Miscellaneous locomotive mechanical defects	1,941	720	2,885	716	604
Wire troubles	81	86	32	11	8
Sickness, death, personal injury	38	25	24	39	11
Wrecking and relief service*	....	4,298	5,460	4,805	3,524
Miscellaneous	1,984	714	2,826	1,056	1,095
Total	39,934	19,701	37,387	23,221	18,412

* During the year 1921 instances of excess service caused by wrecking and relief service were not segregated, but were included under such causes listed in this table as may have required the wrecking and relief service.

A comparison of the results of safety appliance inspections with previous years.

	1921	1922	1923	1924	1925
Freight cars inspected	865,858	1,046,964	1,117,355	1,128,258	1,167,980
Per cent defective	5.34	4.35	8.49	4.47	3.48
Passenger cars inspected	20,082	26,116	22,038	21,359	22,526
Per cent defective	0.87	0.97	1.27	1.54	1.19
Locomotives inspected	21,353	23,590	23,236	23,283	26,664
Per cent defective	2.80	2.40	3.64	2.89	2.10
Number of defects per 1,000 inspected	52.36	50.54	100.31	52.73	42.46

were air brakes cut out, 4,089 cylinders and triples not cleaned within 12 months, 1,516 loose brake pipes, 2,255 missing release rods, 500 defective or loose retaining valves, 1,861 defective retaining pipes, 769 with excessive piston travel, and 2,601 inoperative air brakes.

Handholds—A total of 3,589 handhold defects were reported of which 1,119 were bent, 525 loose, 551 missing, 312 with wrong dimensions, 449 with improper clearance and 483 applied incorrectly.

Ladders—The inspectors reported 1,873 defective ladders of which 632 were bent treads, 224 loose treads, 287 missing treads and 149 without footguards.

Running boards—A total of 2,661 running board defects were reported of which 678 were broken, 1,028 loose, 619 with loose braces and 113 with broken cleats.

Brake shafts—Of the 1,225 brake shafts reported defective 476 were bent, 130 were wrong dimensions and

The number of freight and passenger cars and locomotives inspected, the number found to be defective, and the percentage defective each year for the past 10 years

Year	Inspected	Defective	Per cent defective
1925	1,214,170	41,426	3.41
1924	1,172,900	51,387	4.38
1923	1,162.629	96,024	8.25
1922	1,096,670	46,370	4.22
1921	907,293	47,040	5.18
1920	911,537	40,416	4.40
1919	1,078,361	38,551	3.57
1918	1,119,451	42,448	3.79
1917	1,166,759	41,378	3.54
1916	967,507	35,372	3.65

399 were missing brake shaft cotter keys at the bottom or the brake shaft not properly secured to prevent it from raising out of the operating position.

Brake wheels—The inspectors reported a total of 616 defective brake wheels, the main item of which consisted of 442 with insufficient clearance.

Ratchet wheels—Of the total of 547 reported defective, 494 were loose.

Brake pawls—A total of 560 defective brake pawls were reported of which 279 were loose and 129 inoperative.

Brake steps—A total of 280 defective brake steps were reported of which 147 were broken and 76 loose.

Brake chains—The inspectors reported 848 defective brake chains of which 106 were disconnected, 294 were of wrong dimensions, and 347 were incorrectly secured to the shaft.

Brake beams—Of the total of 861 reported defective, 663 were defective beams or attachments and 132 missing brake shoes.

One of the tables in the report presents separately for individual railroads on which 500 or more cars were inspected, the number of defects reported for each of the 41 classifications of safety appliance defects. Another contains a list of the roads on which inspections of freight cars were made during the year, together with the number of cars inspected and the number and percentage found defective; similar figures for the same roads are also furnished for the four preceding years. These two tables disclose a representative condition of equipment during the past year, and furnish data for comparative purposes covering a five-year period.

Two other tables contain the results of tests of air brakes on trains made by the inspectors of the Bureau of Safety. One shows that during the year air brake tests were made on 2,166 trains made up for departure from terminals, these trains consisting of 75,883 cars; air brakes were found operative on 74,748 of these cars, the average percentage of cars in trains which were controlled by air brakes being 98 per cent. The other shows that during the year air brake tests were made on 935 trains arriving at terminals, these trains consisting of 38,782 cars; air brakes were found operative on 36,624 of these cars, the average percentage of the cars in the trains which were controlled by air brakes being 94.

Hours of service

During the year ended June 30, 1925, hours-of-service reports were filed by 1,148 railroads. Of these railroads 788 filed reports showing that no service in excess of the limitations prescribed by law was performed by their employees; the other 360 railroads reported a total of 37,497 instances of all classes of excess service. As compared with the previous year this is a decrease of 10,725 instances, or a reduction of 22.2 per cent.

The causes of instances in which train-service employees remained on duty longer than 16 consecutive hours, as shown by the Statistical Analysis of Carriers' Monthly Hours of Service Reports for the past five fiscal years, have been arranged in the table for the purpose of comparison.

The foregoing table shows a decrease of 4,809 instances in which employees remained on duty longer than 16 consecutive hours as compared with the number reported for the preceding year, a reduction of 20.7 per cent.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility divided on same pair of wheels

On October 20, 1923, the Chicago, Burlington & Quincy issued a defect card for a cut journal under Southern car No. 269136 when it was delivered to the Union Pacific. The U. P. when changing the wheels found one wheel to be scrap because of brake burns and the other wheel condemnable by use of the remounting gage because of a warm flange. The U. P. rendered a bill to the C. B. & Q. for the labor, brasses, box bolts and the difference in value between the one wheel condemned by use of the remounting gage and the new wheel applied. The difference in value between the other wheel, which was condemned on account of brake burns and the new wheel applied, was charged to the car owner. The handling line contended that a wheel condemned by the use of remounting gage when associated with an owner's defect on the mate wheel, is chargeable to the car owner regardless of the association of a cut journal on the axle with the same wheels. The owner maintained that Interpretation 3 of Rule 98, places the responsibility for the wheel condemned by the remounting gage with the company responsible for the wheel exchange regardless of the fact that the mate wheel may have owner's defects.

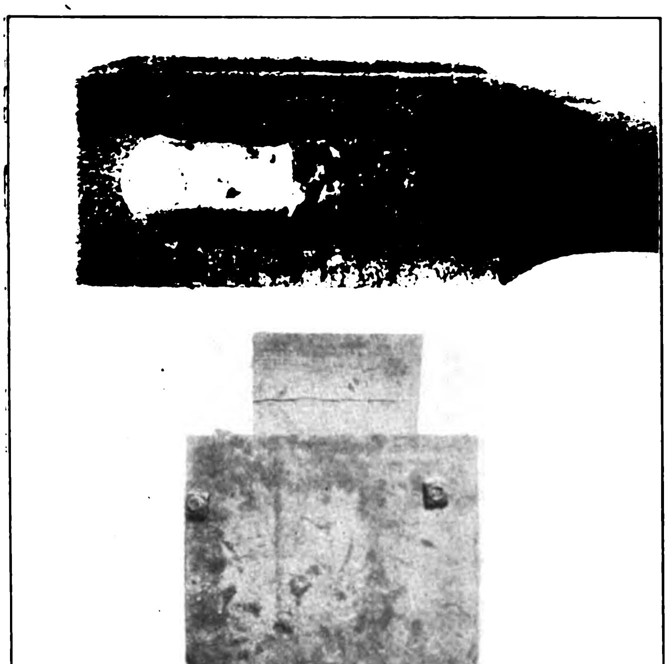
The Arbitration Committee rendered the following decision: "In such cases of divided responsibility on the same pair of wheels, the responsibility for delivering line defects included the wheel flange condemned by the remounting gage, as intended in Interpretation No. 3 to Rule 98. Therefore, the contention of the Union Pacific is sustained."—*Case No. 1353. Union Pacific vs. Chicago, Burlington & Quincy.*

Reclaiming locomotive main rods

Rods weakened by repeated reaming operations are restored to original strength by Thermit welding

By Joseph Murphy
General foreman, Boston & Albany, West Springfield, Mass.

A STEEL back end main rod strap is difficult to hold securely owing to the heavy stresses set up in the reciprocating parts of a locomotive. In time, owing to repeated reaming at each shopping, the holes become so large that both the rod and strap are weakened to such an extent that they cannot be continued in service.

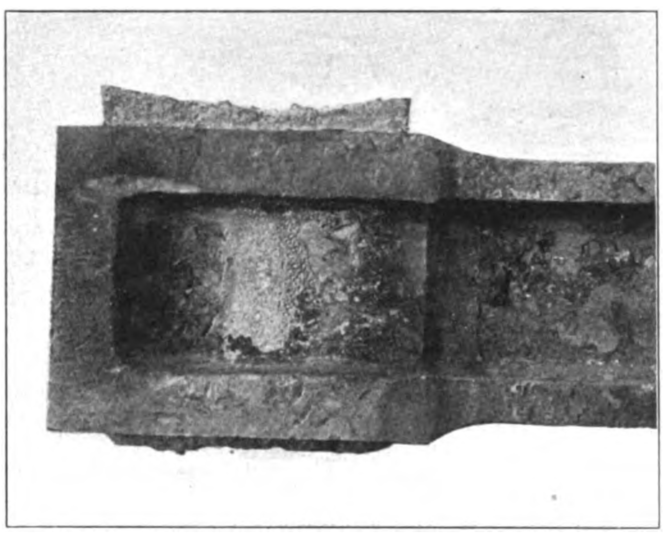


The top view shows the wax mold in place while the lower view shows the mold box and the position of the wooden riser plug

About three years ago we conceived the idea of filling these holes with thermit steel and reclaiming the rod by a process which has proved satisfactory and profitable.

Preparing the rod

The stub end of the rod is thoroughly cleaned and three wooden plugs are driven into the holes at the small end of the taper. The plugs are waxed, as shown in one of the illustrations. The rod is then placed so that the plugs

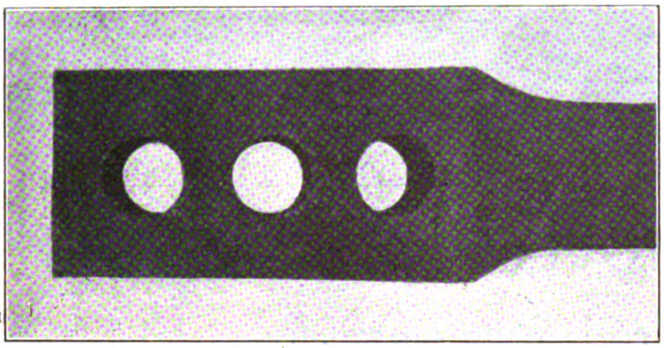


The appearance of the weld before machining

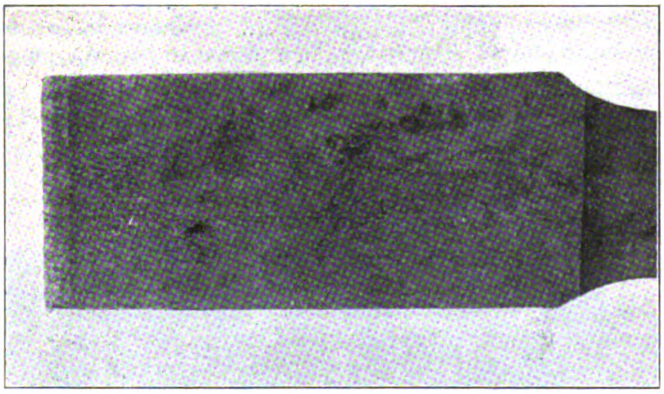
are on the bottom. A sheet steel box 14 in. long, 10 in. wide and 14 in. deep, constructed of 3/16-in. steel is set on the end of the stub so that there is a clearance of about 2 in. between the rod and the bottom of the box to allow for the ramming of the sand under the rod. This box

serves to hold the mold which is built around the rod. The sand is rammed at the bottom and sides to the top of the rod. A wooden block is then placed over the holes, the base of this plug being sufficiently wide to project about ¼ in. beyond each side of the holes. The sand is then rammed around this block, and the edge of the mold dented to prevent the metal and slag from flowing over the box. The plug is then removed, thus forming a riser for the metal. The end of the rod with the box and mold is then inserted into an oil furnace and allowed to heat for two hours to bring the temperature to 1,550 deg. F.

While the rod is heating the welder prepares his crucible. About 40 lb. of railroad thermit is charged into the crucible, the ignition powder placed on top and the cover applied, after which the crucible is suspended from a jib crane to allow for adjustments. The rod is then removed from the furnace, levelled and all particles of sand and scale blown out of the holes. The crucible is then adjusted so that the tap is directly over the riser and high enough so that it can be swung over, if necessary after tapping the mold. The reaction is started and 25 to 30 seconds later the crucible is tapped. The plugs which have been burned during the preheating rise to the top, allowing the thermit metal to fill the impression made by them at the bottom of the mold. The weld is then allowed to cool for about 14 hr. after which it is stripped as shown in one of the illustrations. The rod is then machined in the usual manner.



The stub end of the rod thoroughly cleaned preparatory to the Thermit weld



The rod looks like a new one after machining

The total cost of the operation, including labor, cost of material and subsequent machining, is $24.50 a rod. The cost of a new rod is approximately $136, showing a saving of about $111.50 a rod.

The effect of high temperatures on original steel

When we first started to use this process it was suggested that the high temperature of the thermit steel might have a deteriorating effect on the structure of the original steel with the possible result of a rod failure on the road. As a result of the suggestion we made a test which proved to our satisfaction that such a condition did not actually occur.

A rod was prepared in the ordinary way; that is, the mold was built around the butt end and this portion of the rod, together with the mold, was preheated in the furnace to about 1,500 deg. F. The thermit was then poured and the mold allowed to cool for 14 hours before stripping. This permitted the welded end to cool slowly and refine the grain.

After stripping the mold, the entire rod was annealed after which 1-in. holes were drilled through the poured thermit. The butt end was then cut in two, splitting it longitudinally. The piece was also fractured at the point where the weld was made. It was found that the weld was perfect and homogeneous. A specimen was cut off the portion of the rod containing the original steel, fractured, and the grain at the fracture compared with the fracture across the weld. It was found that the grain had not become coarser on account of the extreme thermit heat and was practically like the original stock. Several scleroscope hardness tests were made. The welded specimen tested 29 hard, while the original stock tested 31 hard, the difference of which is of no moment.

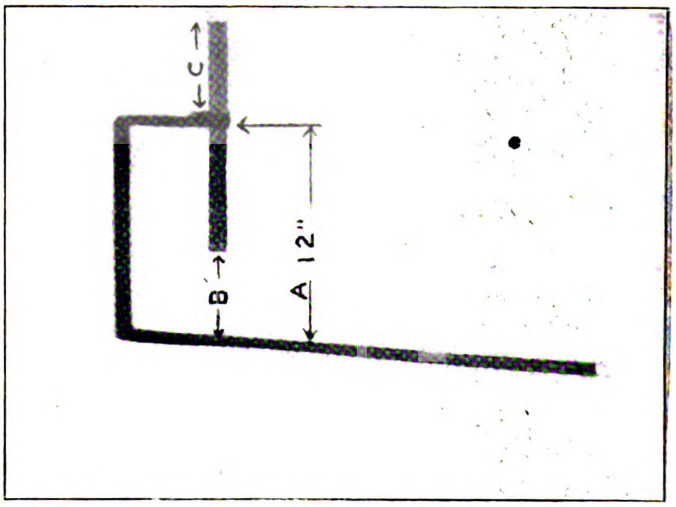
Providing that the mold after pouring is allowed to cool slowly before stripping, the steel has a tendency to refine its grain and will have practically the same structure as the original stock of the rod. The lower scleroscope reading on the welded metal is undoubtedly due to the fact that the material in this section of the rod had been annealed twice and was a trifle softer.

Crown brass and saddle seat gage

By *J. R. Phelps*

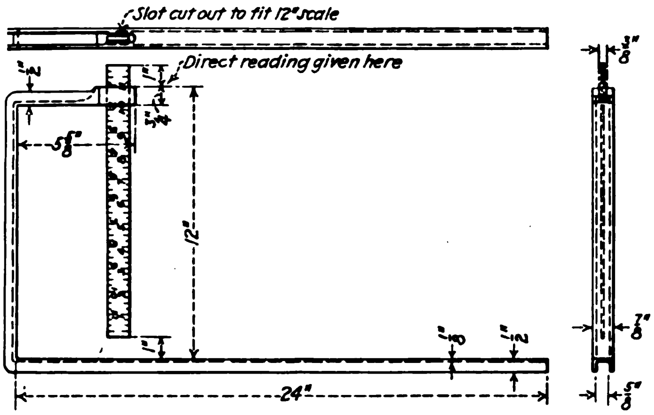
Apprentice instructor, A. T. & S. F. shops, San Bernardino, Cal.

THE accompanying illustrations show a gage for giving a direct reading of the distance from the crown of the driving box brass to the saddle seat. As shown in the photograph, the distance marked *A* is just 12 in. and by placing a 12 in. scale in the slot of the gage the distance *B* and *C* will always equal each other. Consequently, by placing the gage on the driving box, the



As the rule is moved the distance B and C is always equal

amount the scale extends through the slot in the gage will be the distance from the crown of the driving box brass to the saddle seat. This gives a direct reading and



Gage for measuring the distance from the driving box saddle to the crown of the brass

eliminates the chances of error so likely to occur in the old way of using straight edges and substracting the one distance from the other.

Hydraulic jib crane for the boiler shop

By H. J. Raps

General boiler foreman, Burnside shops, Illinois Central, Chicago

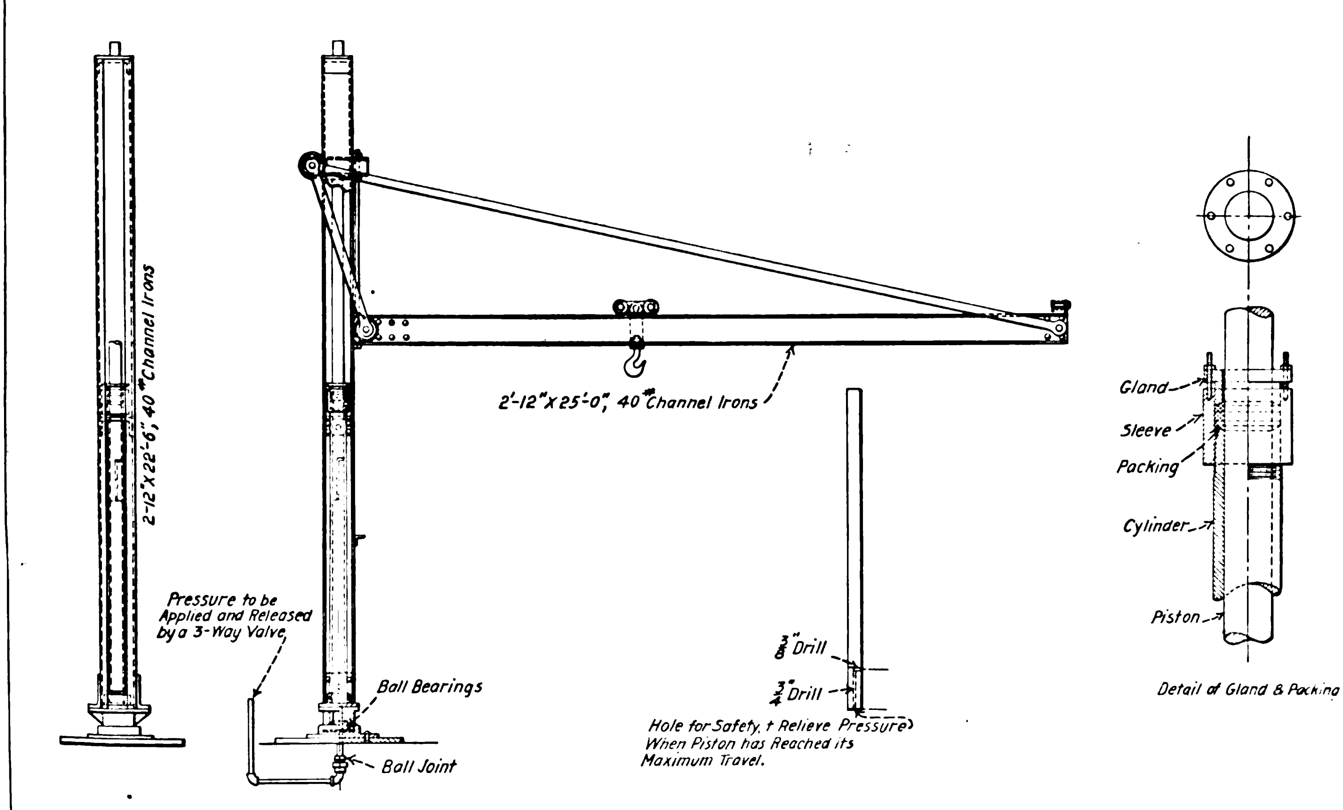
An improved design of jib crane as compared to those of the usual type, has recently been installed in the Burnside shops of the Illinois Central, Chicago. This crane is equipped with a boom which can be raised or lowered to any height desired, by hydraulic pressure. The cylinder is of 5¼-in. inside diameter, made of 7/16-in. sheet metal, and is located between the two channels composing the mast. The piston is 4½ in. in diameter and operates a piston rod secured directly to the main truss rod support of the boom. Referring to the drawing, the weight of the load on the main truss rod is carried on a roller which runs on the side of the mast. The thrust of the boom is carried on another roller which runs on the opposite side of the mast. Pressure in the cylinder is regulated by means of a three-way valve equipped with a lever handle located in a position convenient for the operator. The pressure maintained in the cylinder while the crane is in use is from 1,000 to 1,200 lb. per sq. in. The bottom end of the mast is carried on ball bearings.

The manner of raising the boom is a considerable improvement over jib cranes of similar design. On designs of jib cranes previously used in these shops, the boom was extended between the two channels composing the boom, and the piston connected directly to the boom. In the new design, the piston connection is opposite the upper sheaves, which increases the capacity of the crane.

The details for this crane were worked out by Joe Millray, assistant boiler foreman, and Frank Cummings, machine shop foreman, under the supervision of Frank P. Nash, general foreman, Burnside shops.

Fixture for planing eccentric arms

The fixture, shown in the accompanying illustrations, for planing eccentric crank arms is simple, solid and quickly set up so as to leave the top surface clear for the use of two planer heads. The essential parts of the fixture are the eight expansion straps and grips. A loose part, or a pawl, forms one end of the strap. The angles at which these pawls are cut are not essential



Drawing showing the detail construction of the hydraulic jib crane—Capacity seven tons

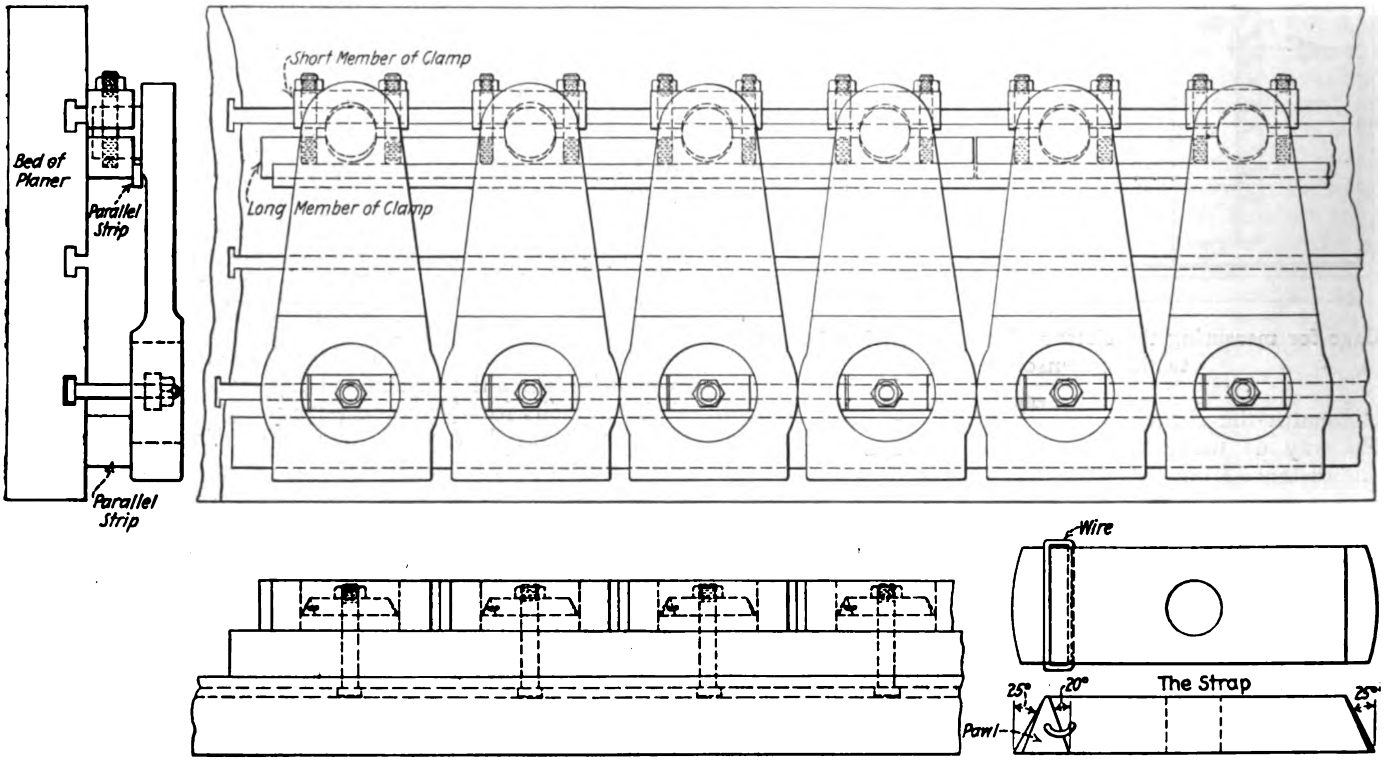
but have been found to work well. A No. 30 hole drilled through the pawl and the strap allows the pawl to be wired to the strap with spring wire which insures it being in place.

The end of the strap and the pawl are rounded to approximate the hole in the eccentric arm. The length of the strap plus the pawl is the diameter of the eccentric arm hole. When placing the strap in eccentric arms, the pawl is pressed down with the finger. When in place, the pawl is released and the bolt is drawn up tight, which securely holds this end of the strap in place.

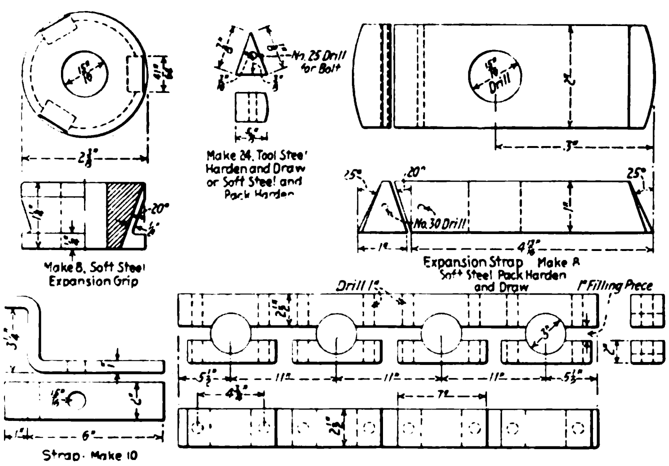
The other end of the crank arm is held by a clamp which consists of a long member, spanning four or more crank arms and a short member at each crank pin. These are clamped by two bolts or studs screwed into the long member and over which the short member goes freely. When making this clamp, it should be held apart by shims and bored a little smaller than the diameter of the hole in the crank arm to be held. Two clamping straps to each long clamp member will be found sufficient to hold the work to the planer. The large end of each crank arm is held to the planer bed by a ⅞-in. bolt through the expansion strap.

After one side of the work is planed, they are turned over, with the finished surface on the planer bed and with the expansion straps still in the crank arm holes. The other end of the arms, supported by parallel straps, are held with ordinary planer straps, keeping the bolts and the straps behind the crank arm pin.

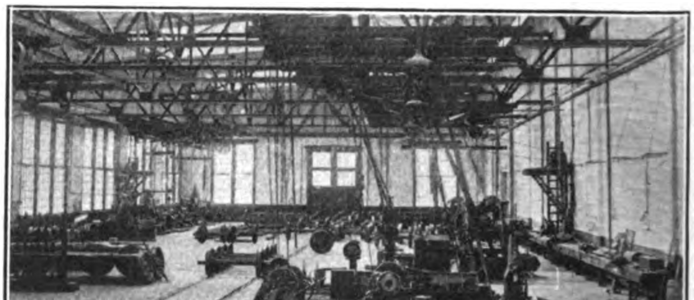
This device has been designed and regularly used with marked success at the North Billerica shops of the Boston & Maine.



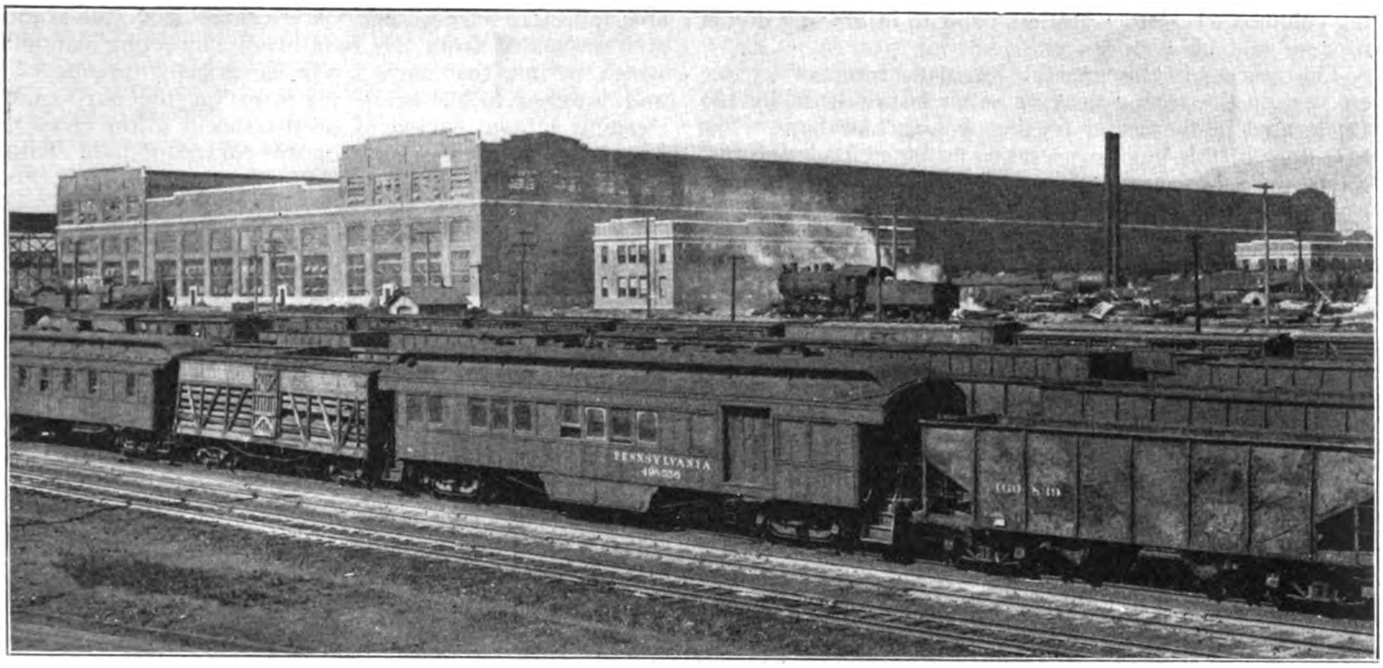
Method of mounting eccentric arms on the planer bed



Details of fixture for planing eccentric arms



Efficient work is impossible without good light and clean surroundings—View shows the possibilities in a car machine shop with large window areas and white painted walls



General view of the Pennsylvania Juniata locomotive repair shop, showing the two welfare buildings, one at each end of the east side of the shop

Repairing locomotives at Pennsylvania Railroad Juniata shop

Scheduling system, material delivery, inspection methods, and standardized repair parts, outstanding features

Part I

THE Pennsylvania Railroad operates 7,103 locomotives, among which are 598 class I1s Decapod type, 574 class L1s Mikado type, 60 class N1s and 130 Class N2s Santa Fe type, and 325 class K4s heavy Pacific type locomotives. These locomotives are heavy modern power which require, for economical maintenance, modern shop facilities and machine tool equipment. Many of the smaller shops in which these locomotives were repaired were not properly equipped to handle them to say nothing of the fact that the full capacity of these shops was needed to handle other classes of power. As a result of these conditions, it was decided to build a locomotive repair shop embodying features of design and equipment, especially adapted to handle the types of locomotives above enumerated.

The new facilities, shown in heavy lines in the plant layout drawing, which consist of an erecting and machine shop building, a flue shop, a carpenter shop, a storehouse, two welfare buildings, a power house, a 110-ft. turntable and two outside overhead crane runways, are additions to the previously existing facilities of the Juniata shops, located east of the city limits of Altoona, Pa. The erecting and machine shop, which is of the transverse type is 691 ft. long and 346 ft. wide and is divided into four 85 ft. bays, of which the outer two are for the erecting pits and tracks and the inner two for the machine shop. It will be seen from the plant layout drawing that this building lies almost at an angle of 45 deg. with the cardinal points of the compass. For the sake of simplicity and clearness in referring to various locations in the shop, the ends of the building will be referred to as north and south and the sides as east and west, the east side being that towards the turntable.

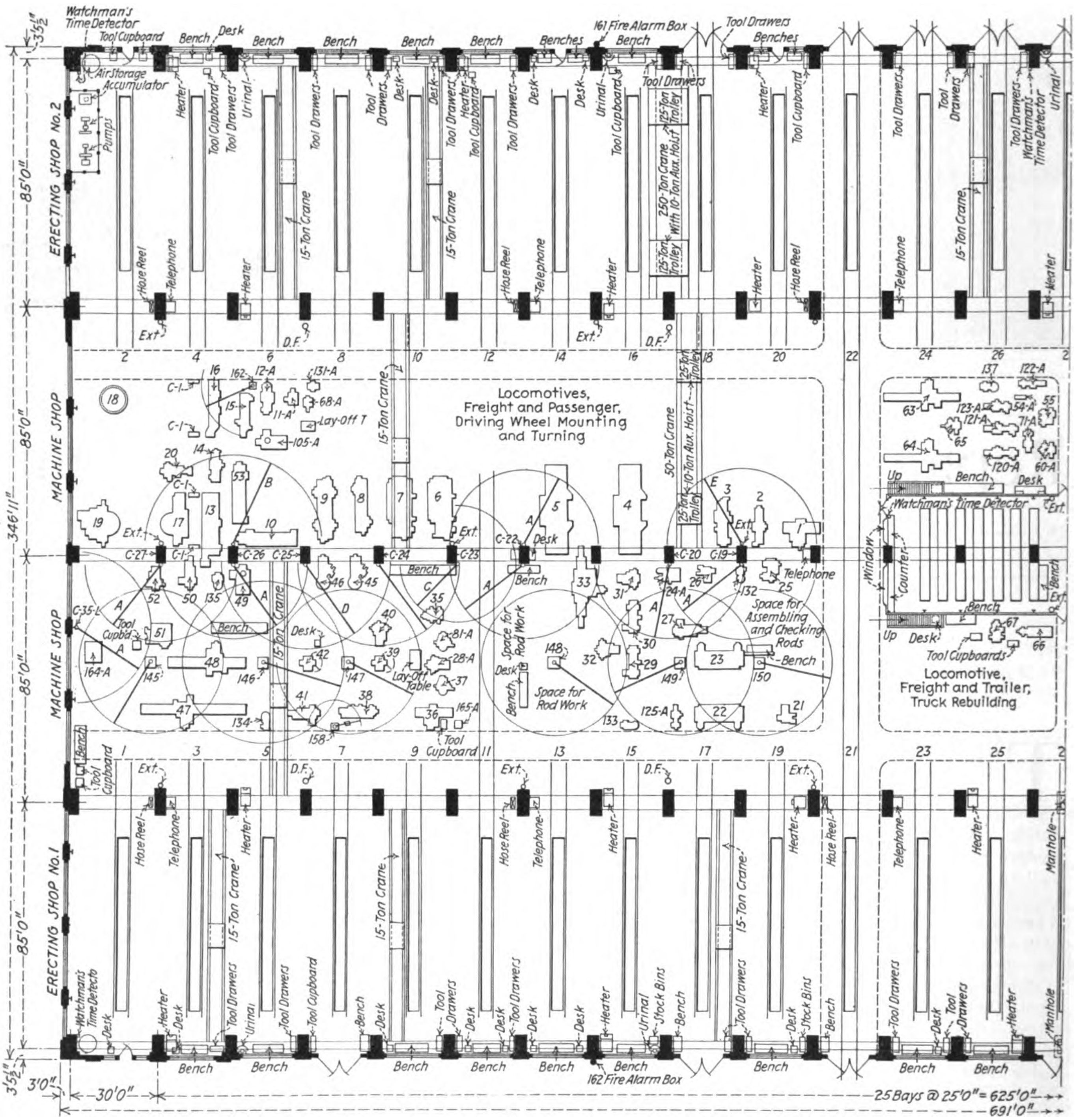
Each erecting bay has 25 pit tracks with 25-ft. centers and two entrance and exit tracks, making 27 tracks for each bay or a total of 54 tracks in the shop. Each erecting bay has two crane runways upon the upper of which is a 250-ton crane with two 125-ton trolleys. This is used for lift-over service for the full length of the shop. The lower runway in each bay carries five 15-ton traveling cranes. Each erecting pit is supplied with outlets for air, electric lights, steam and water for washing and testing, etc. The steam pressure is 300 lb. and the water pressure 400 lb. for boiler testing. There are also connections to the sewer for boiler blow off.

Each machine bay is served by one 50-ton, double trolley crane and two 15-ton single trolley cranes. These bays are well supplied with electrically-operated pillar and jib cranes, there being a total of 35 of these units ranging in capacity from 1,000 lb. to 2,000 lb. They serve the machines on which the heavier work is performed, such as machines for driving boxes, main and side rods, etc.

All the machine tools shown in the accompanying list are motor driven and push-button controlled. The wire conduit is laid in the floor. Practically all of the electrical control apparatus, such as starting rheostats, circuit breakers, etc., is mounted on the center row of the build-

ing columns where they are less liable to injury and do not take up valuable floor space.

The offices of the general foreman, foreman, clerks, etc., are in the second floor of an enclosure 40 ft. by 125 ft., located in the center of the two machine bays. The first floor of this building is taken up by a circulating tool room and storehouse. All small hand or portable tools are stored, serviced and checked out in this tool room, and small supplies, such as bolts, nuts, etc., for immediate use are kept in the storehouse.



The north end of the main shop showing the machine tools and shop equipment used for repairing driving boxes, wheels, rods, and bolts and nuts

Method of lighting the shops

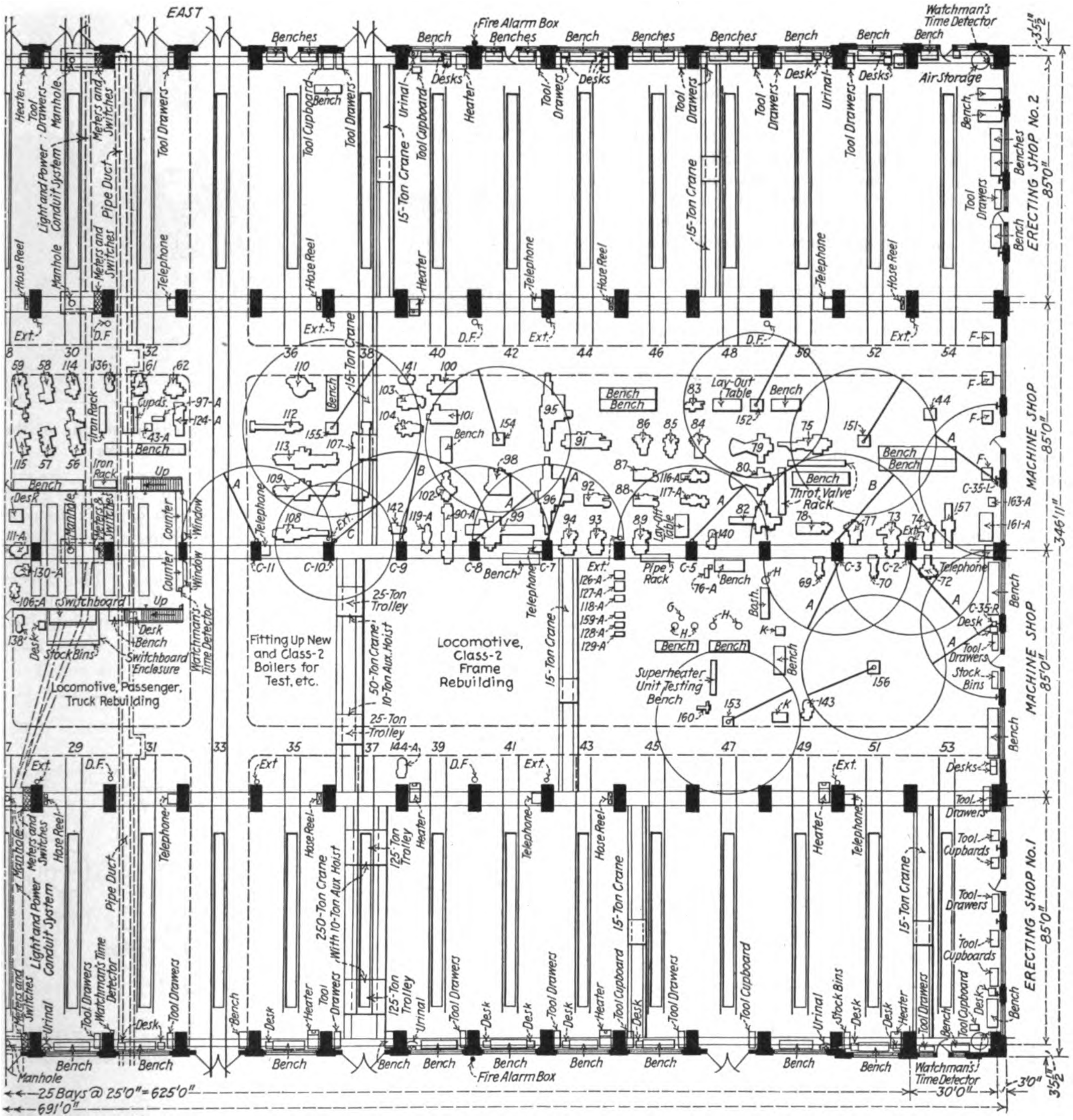
The column to column sections of the machine shop bays are each lighted by three 500-watt lamps with suitable reflectors. These lights are located above the cranes and suspended from the roof by disconnecting hangers, which permit the lamps to be electrically disconnected and lowered to the crane platform for the purpose of cleaning without danger of electric shocks to the cleaners. The lamps in each bay section are controlled by a switch located on one of the center columns, enabling each gang to control its individual lighting requirements. In addition, each machine tool is equipped with an individual light for close work such as setting up, measuring, etc.

The two erecting bays are lighted by overhead lamps similar to those in the machine bays. In addition, each side of each track is lighted by two 500-watt lamps located in wide angle reflectors, one of which is located on the

side column between the upper and lower crane runways and one below the lower crane runway. The two lamps on each of the columns are controlled by a switch on the same column.

The lighting of this shop is satisfactory. Owing to the location on the side columns of the lamps in wide angle reflectors, the light from the upper lamps is cast over the adjacent locomotive and onto the side of the next locomotive. As a result, the side of each locomotive, especially below the running board, is well lighted. The general lighting in the building is ample at any location to read fine print, blue prints, or make up reports.

The space occupied by the outside crane runway along the west side of the shop adjacent to erecting shop No. 1, which is taken up for the storage of heavy locomotive repair parts, for flue rattlers, cleaning vats and other purposes common to erecting shop operations, is lighted by 300-watt flood lights supported on the west wall of the building and similar flood lights on the west crane columns. As a night trick is employed at these shops, it was necessary to provide good lighting so that any class of material could be selected or work performed during this trick.



The south end of the main shop showing the location of the machine tools used for repairing valves and link motion, pistons and crossheads, ashpans, pipe work and miscellaneous work

Construction of new supporting shops

A new flue shop of brick and frame construction, measuring 162 ft. by 45 ft. adjoins the outside craneway near the north end of the main buildnig. The flues are cleaned

in two flue ratters located under the outside crane runway and adjacent to the flue shop. A carpenter shop 151 ft. by 45 ft. is located south of the flue shop. This building is used for repairs to the locomotive cabs and, in addition, for any woodwork which may be necessary on the locomotive and tender, or in the operation of the Juniata shops.

The new storehouse is a three story and basement structure 404 ft. long by 64 ft. wide. It is built of reinforced concrete with brick facing. The basement and first floor are used for material storage while the second floor houses the mechanical and electrical engineering departments and the third floor the general offices of the works manager and his staff.

Two welfare buildings were erected for the shop employees on the ground immediately adjoining the east side of the main shop building. These buildings are two-story structures, each 142 ft. by 41 ft., of structural steel and brick construction. The first floor in each building is equipped with modern steel locker facilities, lavatories and toilets; the second floor has been provided with tables and benches and is used by the men as a rest and lunch room.

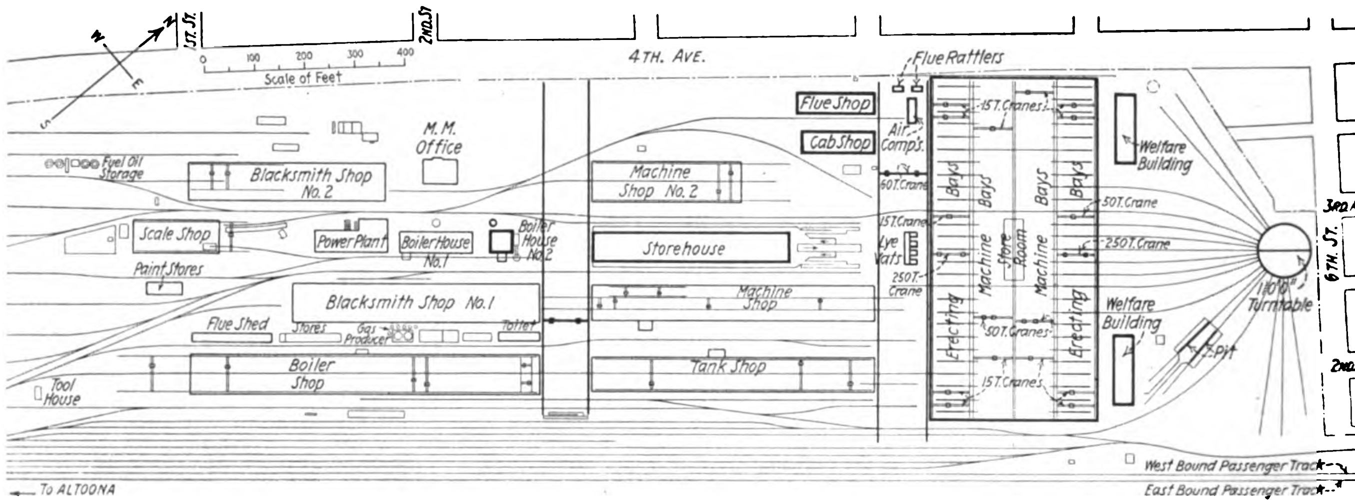
The main erecting shop is served by a 110-ft. turntable, located at the extreme east end of the layout. This turntable serves nine lead tracks to the east erecting bay, known as erecting shop No. 2 and several storage tracks. Two of these tracks are extended through to the west bay which is also reached by other tracks coming in from the west side of the building. The turntable also serves two outside pits located near the erecting shop where finishing touches may be given to repaired locomotives.

Inspecting and stripping locomotives

The four types of locomotives generally repaired in this shop are drawn from the Eastern and Central regions of the Pennsylvania System in about equal numbers. As the locomotives are brought in from outlying points, they are stored in the shop yard located south of the boiler shop and tank shop buildings. Five engines, or one day's shop output, are shifted each night to the inspection tracks located south of the tank shop. Here the engines and tenders are separated and prepared for the shop and are given a preliminary inspection by one boiler and two machinery inspectors. No underneath inspection is made at this time. These inspectors make out the preliminary machinery and boiler inspection reports shown in the accompanying illustrations. The locomotives are then placed on the various storage tracks served by the turntable. About three days' supply of locomotives are generally kept on these tracks to eliminate any possibility of having a repair track waiting for a locomotive and to allow the scheduling department ample time to analyze the inspectors' reports and order any material required for unusual repair jobs.

Erecting tracks Nos. 35 and 37 in erecting shop No. 1 and tracks Nos. 18 and 20 in erecting shop No. 2 are used for stripping the locomotives, which work is done on a three-trick basis. Locomotives receiving Class 1 and 2 repairs (new fireboxes or heavier boiler work) are completely dismantled by the stripping gangs. The boilers are loaded on cars and sent to the boiler shop and the frames to the frame gang located in the west machine bay, adjoining stripping tracks Nos. 35 and 37. Those parts which require cleaning are sent to the cleaning vats and after cleaning are sorted and hauled by electric trucks to the proper repair gangs in the machine bays.

These four cleaning vats located along the west side of the shop are served by electric crane trucks



General plan of the Juniata shops—The new facilities are shown in heavy lines

All machinery, including brake rigging, all pedestal binder nuts, except one at each end of each binder, the cab, the superheater units and the front end equipment are stripped from the locomotives receiving Class 3, 4 and 5 repairs. The stripping gang also removes from these locomotive 10 test flues and 10 test cylinder bolts. The conditions indicated by these test parts help to determine

Machine tools installed at the Pennsylvania Juniata locomotive repair shop classified according to the repair gang in which they are located

Driving box gang

Drawing reference	Number	Description of machines
38	1	30-in. by 11-ft. 6-in. engine lathe
41	1	18-in. slotter
134	1	Tool grinder
47	1	48-in. by 48-in. by 16-ft. planer
164-A	1	44-in. by 60-in. driving box babbitting furnace
51	1	42-in. vertical turret lathe
52	1	Drill press
50	1	18-in. slotter
135	1	Tool grinder
49	1	5-ft. radial drill press
45	1	54-in. driving box boring mill
46	1	54-in. driving box boring mill
40	1	Drill press
39	1	100-ton press
42	1	100-ton press
48	1	48-in. by 48-in. by 12-ft. planer
c-35-L	1	1000-lb., 25-ft. radius column jib crane
c-27	1	1000-lb., 25-ft. radius column jib crane
c-26	1	1000-lb., 25-ft. radius column jib crane
c-25	1	1000-lb., 28-ft. radius column jib crane
c-24	1	1000-lb., 28-ft. radius column jib crane
c-23	1	1000-lb., 20-ft. radius column jib crane
145	1	1000-lb., 25-ft. radius pillar crane
146	1	1000-lb., 28-ft. radius pillar crane
147	1	1000-lb., 25-ft. radius pillar crane
	2	Work benches
	1	Layoff table

Wheel repair gang

Drawing reference	Number	Description of machines
18	1	Tire heating furnace
19	1	100-in. tire mill
20	1	22-in. slotter
17	1	7-ft. boring mill
16	1	Heavy axle lathe
13	1	20-in. by 10-ft. plain grinder
14	1	23-in. by 10-ft. engine lathe
15	1	Axle keyseating machine
53	1	600-ton, 96-in. wheel press
12-A	1	23-in. by 10-ft. engine lathe
11-A	1	Milling machine
131-A	1	Tool grinder
68-A	1	16-in. shaper
105-A	1	5-ft. radial drill press
4	1	90-in. wheel lathe
5	1	90-in. wheel lathe
6	1	90-in. journal lathe
7	1	90-in. journal lathe
8	1	90-in. quartering lathe
9	1	100-in. quartering lathe
10	1	600-ton, 96-in. wheel press
	1	Lay-off table
c-27	1	1000-lb., 25-ft. radius column jib crane
c-26	1	1000-lb., 30-ft. radius column jib crane
162	1	4000-lb., 25-ft. radius, air hoist

Piston and cylinder bushings (part of wheel gang)

Drawing reference	Number	Description of machines
1	1	Milling machine
2	1	23-in. by 12-ft. engine lathe
3	1	42-in. by 14-ft. engine lathe
c-19	1	1000-lb., 25-ft. radius, column jib crane

Main and side rod gang

Drawing reference	Number	Description of machines
35	1	24-in. shaper
36	1	Milling machine
37	1	36-in. vertical boring mill
28-A	1	Drill press
81-A	1	36-in. vertical boring mill
165-A	1	24-in. by 30-in. brazing furnace
33	1	22-in. by 84-in. surface grinder
31	1	Drill press
30	1	Turret lathe
32	1	Drill press
29	1	Turret lathe
133	1	Tool grinder
24-A	1	Plain grinder
26	1	75-ton press
132	1	Tool grinder
25	1	Cylindrical grinder
27	1	18-in. slotter
23	1	Rod boring machine
125-A	1	16-in. by 8-ft. engine lathe
22	1	Rod boring machine
21	1	75-ton press
148	1	1000-lb., 25-ft. radius pillar crane
149	1	1000-lb., 25-ft. radius pillar crane
150	1	1000-lb., 25-ft. radius pillar crane
c-19	1	1000-lb., 25-ft. radius column jib crane
c-20	1	1000-lb., 25-ft. radius column jib crane
c-22	1	1000-lb., 25-ft. radius column jib crane
	3	Work benches

Brass and bolt gang

Drawing reference	Number	Description of machines
63	1	36-in. by 36-in. by 12-ft. planer
64	1	36-in. by 36-in. by 12-ft. planer
65	1	Drill press
120-A	1	16-in. by 10-ft. engine lathe
121-A	1	16-in. by 10-ft. engine lathe
123-A	1	16-in. by 8-ft. engine lathe
137	1	Tool grinder
122-A	1	16-in. by 8-ft. engine lathe
54-A	1	Small bolt centering machine
55	1	Triple head bolt threader
71-A	1	Turret lathe
60-A	1	Bolt altering machine

A—These machines are bolted permanently to the floor but are not set on concrete foundations as are the others.

Drawing reference	Number	Description of Machine
58	1	Turret lathe
59	1	Turret lathe
114	1	Turret lathe
115	1	Turret lathe
57	1	Turret lathe
56	1	Turret lathe
136	1	Tool grinder
	2	Work benches
	2	Iron racks

Small tools and machinery repair gang

Drawing reference	Number	Description of Machine
61	1	24-in. shaper
62	1	Drill press
97-A	1	Small metal saw
124-A	1	24-in. by 10-ft. engine lathe
43-A	1	Small tool grinder
	2	Work benches

Engine truck and trailer gang

Drawing reference	Number	Description of Machine
67	1	24-in. shaper
66	1	Radial drill press
138	1	Tool grinder
	2	Work benches

Piston and crosshead gang

Drawing reference	Number	Description of Machine
110	1	36-in. by 44-in. boring mill
112	1	400-ton, 48-in. wheel press
113	1	36-in. by 20-ft. engine lathe
109	1	36-in. by 20-ft. engine lathe
108	1	Horizontal boring mill
107	1	20-in. by 144-in. plain gap grinder
141	1	Tool grinder
100	1	5-ft. radial drill press
101	1	5-ft. radial drill press
103	1	Vertical surface grinder
104	1	24-in. shaper
102	1	15-in. slotter
142	1	Tool grinder
119-A	1	16-in. by 8-ft. engine lathe
90-A	1	23-in. by 14-ft. engine lathe
98	1	42-in. vertical turret lathe
99	1	48-in. by 48-in. by 10-ft. planer
95	1	22-in. by 84-in. grinder
96	1	22-in. by 84-in. grinder
155	1	1000-lb., 30-ft. radius pillar crane
154	1	1000-lb., 25-ft. radius pillar crane
c-11	1	1000-lb., 25-ft. radius column jib crane
c-10	1	1000-lb., 20-ft. radius column jib crane
c-9	1	1000-lb., 30-ft. radius column jib crane
c-8	1	1000-lb., 25-ft. radius column jib crane
	2	Work benches

Valve and link motion gang

Drawing reference	Number	Description of Machine
91	1	12-in. by 96-in. plain grinder
92	1	10-in. by 24-in. plain grinder
93	1	Cylindrical grinder
94	1	Cylindrical grinder
86	1	Drill press
87	1	10-in. by 24-in. plain grinder
88	1	10-in. by 24-in. plain grinder
89	1	Cylindrical grinder
83	1	75-ton press
84	1	Drill press
85	1	24-in. shaper
116-A	1	16-in. by 8-ft. engine lathe
117-A	1	16-in. by 8-ft. engine lathe
140	1	Tool grinder
79	1	Radius grinder
80	1	Radius grinder
82	1	36-in. by 36-in. by 8-ft. planer
152	1	1000-lb., 25-ft., radius pillar crane
c-7	1	100-lb., 28-ft. radius column jib crane
c-5	1	1000-lb., 25-ft. radius column jib crane
	2	Work benches
	2	Lay-off tables

Pipe gang

Drawing reference	Number	Description of Machine
126-A	1	Pipe threader
127-A	1	Double head pipe threader
118-A	1	Pipe threader
159-A	1	Pipe threader
128-A	1	Pipe cutting machine
129-A	1	Pipe burr removing machine
76-A	1	Copper pipe saw
160	1	Superheater unit testing valves and stand
153	1	1000-lb., 25-ft. radius pillar crane
H	5	24-in. diameter pipe bender furnaces
K	2	24-in. by 36-in. pipe bender's furnaces
G	1	22-in. diameter pipe bender's furnace
	4	Work benches
	1	Superheater unit testing bench
	1	Pipe rack

Miscellaneous gang

Drawing reference	Number	Description of Machine
75	1	Horizontal boring mill
78	1	Radial drill press
77	1	Drill press
74	1	Slotter
73	1	18-in. traveling head slotter
157	1	Stock adjusting machine
161-A	1	13½-in. by 44-in. pedestal cap furnace
163-A	1	18-in. by 30-in. annealing furnace
44	1	Belt driven hammer
151	1	1000-lb., 25-ft. radius pillar crane
c-3	1	1000-lb., 30-ft. radius column jib crane
c-35-2	1	1000-lb., 25-ft. radius column jib crane
F	4	42-in. by 42-in. blacksmith forges
	4	Work benches
	2	Throttle valve racks

Ash pan gang

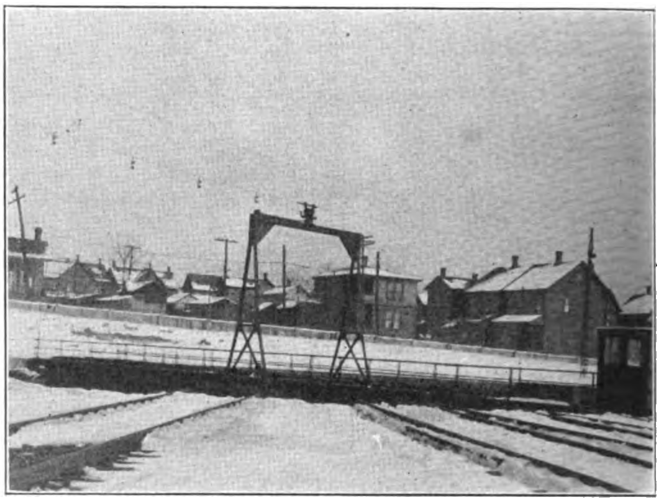
Drawing reference	Number	Description of Machine
69........	1	36-in. shear
70........	1	36-in. punch
72........	1	Drill press
143........	1	Tool grinder
156........	1	1000-lb., 30-ft. radius pillar crane
c-3........	1	1000-lb., 36-ft. radius pillar crane
c-2........	1	1000-lb., 25-ft. radius pillar crane
c-35-R......	1	1000-lb., 25-ft. radius pillar crane
	2	Work benches
		Machine and tool room
111-A......	1	Tool grinder
130-A......	1	Tool grinder
106-A......	1	Drill grinder
	1	Work bench
		Frame gang
144-A......	1	Tool grinder

the amount of repair work necessary. When removal of the flues is necessary, this work is done on the repair track, after which the flues are taken to the flue rattler and cleaned, and then to the flue shop for safe ending and testing, which is supervised by a gang foreman who reports to the erecting shop boiler foreman.

The lagging, spring rigging and flues are not removed as this work is done on the repair track, depending on the nature of the repairs required. After the locomotives to receive Class 3, 4 and 5 repairs are stripped this far, they are moved outside of the shop, if the designated repair track is not empty, where about six or eight of them are usually kept in storage. When needed they are placed on the entrance or exit track pits where they are unwheeled in about one hour, after which they are placed on the repair tracks ready for rebuilding.

The parts requiring cleaning are sent to the four 10-ft. by 15-ft. by 5-ft. steel-lined concrete cleaning vats located outside of erecting shop No. 1. Four perforated steam pipes are located on the bottom of each vat for the purpose of heating and agitating the cleaner. Each vat requires an initial mixture of 1,300 lb. of flake caustic soda and 500 gal. of water, to which 325 lb. of soda is added weekly. The vats are cleaned out every three months.

The parts are here loaded in perforated steel boxes as shown in one of the illustrations. All the lifting is done by crane type electric trucks except placing the steel boxes



This 110 ft. turntable serves nine lead-in tracks to the repair shop

JUNIATA SHOPS
Preliminary Inspection Report - Machinery
Sheet No.1

Loco. No. ....Class.......Divn............Class Reprs.......Date Rec'd.......

Pilot ___ Coupler ___
Bumper Castgs. R. ___ C. ___ L. ___
Center Castgs. Under Cyl. ___
CYLINDER AND SADDLE:
R. Is Cyl. Working ___
Are Bolts O.K. ___
L. Is Cyl. Working ___
Are Bolts O.K. ___
Guides R. ___ L. ___
Crosshead R. ___ L. ___
Guide Yoke R. ___ L. ___
Lift Shaft ___
Link Brkt. Suppt. R. ___ L. ___
Link Bracket R. ___ L. ___
EXPANSION SHEETS:
#1 Top R. ___ L. ___ Bottom R. ___ L. ___
#2 " "
#3 " "
#4 " "
#5 " "
#6 " "
FRAME STIFF CASTINGS:
#1 R. ___ L. ___
#2 R. ___ L. ___
#3 R. ___ L. ___
#4 R. ___ L. ___
SPRING EQUAL. SEAT ON FRAME:
#1 R. ___ L. ___
#2 R. ___ L. ___
#3 R. ___ L. ___
#4 R. ___ L. ___
LATERAL FRAME BRACE:
#1 ___
#2 ___
#3 ___
Boiler Suppt. at Mud Bar R. ___ L. ___
Foot Plate Casting ___
Cab Bracket R. ___ L. ___
Smoke Box Frt.End Ring ___ Door ___
Air Res. Brkts. on Frt. End ___
Running Boards R. ___ L. ___
Stack ___ Bell ___
Sand Box ___ Whistle ___
Safety Valves ___
Hand Rail over Smoke Box ___
Hand Rail on Boiler R. ___ L. ___
Superht. Damper Cyl. ___
Dome Cap & Studs ___

RUNNING BOARD BRACKETS:
R. #1 ___ L. #1 ___
R. #2 ___ L. #2 ___
R. #3 ___ L. #3 ___
R. #4 ___ L. #4 ___
Running Board Brkt. Studs R. ___ L. ___
Air Res.Brkts. R. ___ L. ___
Air Res. Brkt. Studs R. ___ L. ___
Power Reverse Gear ___
Power Gear Bracket ___
Power Gear Brkt. Studs ___
Air Pump ___
Air Pump Bracket ___
Air Pump Brk. Studs ___
Feed Water Pump ___
Feed Water Pump Brkt. ___
Feed Water Pump Brkt. Studs ___
VALVE GEAR:
Link Trunnion Bushgs. R. ___ L. ___
Link R. ___ L. ___
Link Block R. ___ L. ___
Eccentric CrankR. ___ L. ___
Eccentric Rods R. ___ L. ___
Radius Rods R. ___ L. ___
Connecting Links R. ___ L. ___
Lamp & Lead Levers R. ___ L. ___
Valve Stem Xhds. R. ___ L. ___
Back Valve Chb. Hds. R. ___ L. ___
Front Valve Chb. Hds.R. ___ L. ___
Piston Ext. Guide R. ___ L. ___
Piston Ext. Guide Cov.R. ___ L. ___
JACKET:
Bands ___
Barrell ___
Fire Box Inside Cab ___
Outside Cab ___
Fire Door Frame ___ Fire Door ___
Cab ___
Glass Water Gauge ___
Steam & Air Gauges ___
Throttle Lever ___
Blower Rigging ___
Cocks & Valves ___
Inj. Opr. Rigging ___
Lubricator ___
Main Rods R. ___ L. ___
Side Rods R. ___ L. ___

Sheet No. 2

FRAMES:
Main R. ___ L. ___
Front R. ___ L. ___
Rear R. ___ L. ___

REMARKS: ___

DRIVING BOX LATERAL		TIRE THICKNESS		TIRE WEAR	
R.1	L.1	R.1	L.1	R.1	L.1
R.2	L.2	R.2	L.2	R.2	L.2
R.3	L.3	R.3	L.3	R.3	L.3
R.4	L.4	R.4	L.4	R.4	L.4
R.5	L.5	R.5	L.5	R.5	L.5

TIRES: Turn ___ Renew ___

DRIVING BOX JOURNAL FIT		ENGINE TRUCK LATERAL	
R.1	L.1	R.1	L.1
R.2	L.2	R.2	L.2
R.3	L.3		
R.4	L.4	TRAILER TRUCK LATERAL	
R.5	L.5	R.	L.

Broken or Missing Locomotive and Tender Parts

Date Inspected ___ Inspector ___

This detail report is filled out by the machinery inspectors when they examine a locomotive received at shop for repairs

in vats which is done by the overhead crane. There are several sizes of boxes designed to fit and fill the vats in connection with each other, the medium size, being designed to hold 10 driving boxes and 10 pedestal binders, all from a Decapod locomotive. The parts remain in

General view of the east machine bay showing a part of the wheel gang

the bath about 2 hr., after which they are removed, rinsed in warm water and then distributed for repairs.

Shop organization

About 1,950 men are employed in this shop under the direct supervision of a general foreman. Each erecting bay consisting of 27 tracks (23 of which are used for erecting work) is supervised by an erecting foreman. Each daylight erecting foreman has under his jurisdiction five track gangs, two pipe gangs, two steam pipe gangs and one valve motion and brake rigging gang, each supervised by a gang foreman. The night foreman who is the stripping foreman has charge of two track gangs, one pipe gang and one steam pipe gang in each erecting shop in addition to his stripping organization, which completes out-going locomotives and work on those receiving extra heavy repairs.

Each erecting bay has a daylight assistant boiler foreman who reports to the boiler shop foreman. Each of these two men has charge of a flue gang, two boiler repair gangs and two ash-pan gangs on the daylight force and one flue gang, two boiler repair gangs and two ash-pan gangs on nights who report to the day organization and are handled by the stripping foreman. The boiler repair gangs make all repairs to the boilers in the shop, give boilers special staybolt examination, apply all patches, sheets and bolts necessary to remove and reset the flues. They also cut out and apply flues to all Class 1 and 2 repair locomotives. They also remove and replace cabs, running boards, front end arrangement, and ash-pans.

When a Class 1 or 2 repair boiler comes from the boiler shop, the boiler trimming gang in the machine bay applies all boiler fittings and finishes the boiler ready for testing. The usual procedure is to test and steam the boiler and apply the lagging and jacket before it is put on the frame.

The stripping foreman dismantles all the locomotives and his inspectors cover the locomotive machinery and pipe parts as dismantled and authorize all the repair work. The boiler is not given its final inspection until it is placed either on the erecting track or in the boiler shop.

Other foremen, reporting directly to the general foreman, are the tank shop foreman, the carpenter shop foreman, three machine shop foremen, a piece-work foreman and a schedule foreman.

There are piece-work inspectors reporting to a piece-work foreman who approves the finished work and authorizes the payment designed on the piece-work charts. The piece-work foreman handles all questions pertaining to piece-work prices, etc.

Of equal importance is the schedule foreman whose inspectors examine the locomotive when received at the shop and from whose reports the general repairs and schedule time is determined. From this basis the schedule times for the parts to be returned to the locomotive and operations to be completed are set as well as the date the locomotive is to go out of the shop. The schedule foreman also controls the cleaning and delivery of all materials from the cleaning vats and storehouse.

How the schedule department functions

The schedule foreman has under him a boiler and two machinery inspectors whose duties are to inspect the loco-

Machine Shop Repair Items

Description	From E.S. Due	From E.S. Del.	To E.S. Due	To E.S. Del.	Remarks
Crossheads					
Pistons					
Guides					
Driv. Boxes					
Wheels, Cranks					
Main Rods					
Side Rods					
Trailer Truck					
Engine Truck					
Piston Packing					
Cocks & Valves					
Power Reverse					
Screw Reverse					
Reverse Lever					
Feed Water Pump					
Stoker					
Throttle Rigging					
Spring "					
Brake "					
Link Motion					
Eccen. Rods					
Piston Valves					
Chamber Heads					
Throttle Lever					
Reach Rods					
Lift Shaft					
Link Brackets					

Erecting & Boiler Shop Repair Operations

Operation	Due	Comp.	Remarks
Stripped & Work Dist.			
Loco. placed on Rep. Trk.			
Flues out			
Flues in			
Flue Work completed			
Boiler washed			
Boiler work comp.			
Frames & Cyl. work comp.			
Caps & Spring Rigging up			
Lift Shaft erected			
Shoes & Wedges layed out			
Loco. Wheeled & Trammed			
Guide Pist. & X-Hd. erec.			
Rods erected			
Stokers on			
Valve & Link Motion erec.			
Valves set			
Boiler closed & tested			
Units in & tested			
Ash Pans up, Grates in			
Cab on			
Lagging & Jacket on			
Pipe work completed			

Remarks________

Loco. No.______ Class______ Repairs______ In Shop______

Scheduled out______ Completed______ Bay No.______ Trk. No.______

This form is filled out by the schedule foreman and the information is posted on the shop schedule boards for each supervisor in the shop

motive when received at the shops. These inspectors make a record on a form of every part inspected. In addition, when the locomotives are being stripped and after the locomotives are placed on the repair tracks, the stripping foreman and track gang foreman make an inspection and report to the schedule foreman any unusual conditions or exceptionally heavy work which was not included on the original inspector's report. After this information is assembled the scheduling department determines the time required to repair each part and the time at which each locomotive is to leave the shop. This information is filled in on the blank form shown in one of the illustrations, and the information given to each repair gang foreman by placing it on his schedule board. It is also entered on a master schedule board located in the schedule foreman's office. The list of parts on this board is arranged in the same way as that on the foreman's forms, with enough vertical columns to take care of one month's output.

As the locomotives are rebuilt, the schedule foreman closely follows the time schedules and sees that the parts are delivered to the repair tracks on time. He considers time only and does not pass on the quality of workmanship, this being the function of the gang foreman and piece-work inspectors. As each part is repaired and placed on the locomotive, the gang foreman first examines the work, after which the piece-work inspector finally passes it. If it meets with his approval he O.K.'s the piece-work charges and authorizes payment to the men for the work which they have performed.

Another function of the scheduling department is to order all materials and have it delivered to the repair tracks, the machine bay repair gangs or the working and stock bins. Twenty telephone booths, located in the erecting and machine bays are connected with a switchboard located in the schedule foreman's office. As each gang foreman needs material he calls up the office, tells what material he wants, how it is to be charged and where it is to be delivered. This information is put on a material order slip which is taken at 20-min. intervals by a messenger to a labor leader located at the main storehouse. There are three labor gangs under the schedule foreman, each handling a certain line of material. The orders are then filled and delivered by electric trucks to the designated points. All repaired parts are delivered to the pit tracks by the repair sections. The purpose of this system is to keep the repairmen busy and not waste time going after new or repaired parts.

Material bins are conveniently located about the shop. In these are kept about 2,500 different small parts. The schedule foreman assigns a labor gang with electric trucks to keep these bins filled. This gang devotes all of its time to watching the bins, drawing the material from the main storehouse and properly piling it in the bins. Each month's material charges are distributed over the number of locomotives turned out during the month.

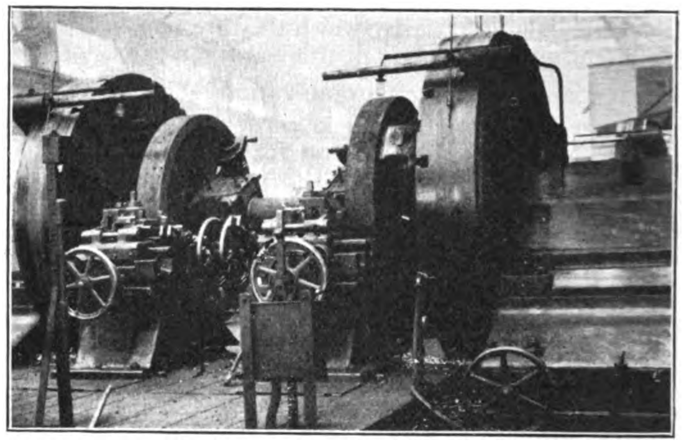
The reclamation of scrap also comes under the supervision of the schedule foreman. All the scrap material is hauled out to the scrap platform located at the east end of the storehouse. Here it is inspected by one man who passes on every piece and picks out what he thinks can be reclaimed and the remainder is thrown into the scrap car. He also routes it to the proper shop for any reclamation work necessary.

Organization of the machine bays

The two machine bays are supervised by three foremen. Starting at the north end of the machine bays, the first foreman has charge of wheel, box, rod and truck repairs. The foreman in the middle of the machine bays has charge of the repairs to pistons, crossheads and guides, valve and link motion work, brass and bolt work, brake and spring rigging and miscellaneous work. The third foreman at the south end of the shop has charge of Class 1 and 2 boiler repairs, repairing frames, superheater units, pipe, ash pans, welding and cutting work and the tool-room and machinery repair work.

Standardizing repair parts

The Pennsylvania Railroad for many years has been working towards the standardization of repair parts for locomotives. As a result, practically all new parts, such as crank and knuckle pins and bushings, valve motion parts, piston valves and bushings, shoes and wedges and similar parts are semi-finished in other departments. This practice reduces the work in the two machine bays to a minimum. As an illustration, all valve motion pins and bushings are blanked out to establish step sizes on automatic screw machines and then case-hardened in the automatic shop which is a unit of the Altoona machine shops. The bore of the bushings and the body or bearing surface of the pins are ground to gage sizes by quantity production methods. Therefore, it is only necessary when fitting these parts to the locomotives, to grind the outside of the bushing and the two tapered ends of the pins. Suitable gages and micrometers are provided which reduce



One of the large wheel lathes—Note that the driving boxes are on the pair of wheels in the lathe

the time of fitting to a minimum. Practically the same methods are followed for side rod knuckle pins and bushings, crank pins, etc. The result of supplying these semi-finished parts to the new shops is reflected in the number of machine tools installed in the new machine shop bays which is smaller per locomotive repaired than in the general average of locomotive repair shops.

As one passes through the machine bays there is a noticeable absence of filing operations. This is made possible by the liberal use of plain, cylindrical, internal and surface grinders, milling and other machines, some of which have been fitted up for one particular operation. The experience at Altoona has shown the economy of assigning a machine to a single specified job and fitting that machine with all possible labor saving devices wherever a sufficient volume of work is available.

One also soon becomes aware of the fact that the machine operators rarely leave their machines to take measurements, a condition that has been brought about by the liberal use of micrometer calipers and size blanks. The use of accurate measuring devices has made it practicable for the inspectors to measure and set down on specially prepared blanks* the dimensions to which the

*There are nine of these dimension blanks, four of which are used to illustrate the article. The other five show cylinder and valve chamber sizes, pedestal cap sizes, piston rod and crosshead pin sizes, guide and crosshead sizes and a report on side rod brasses.

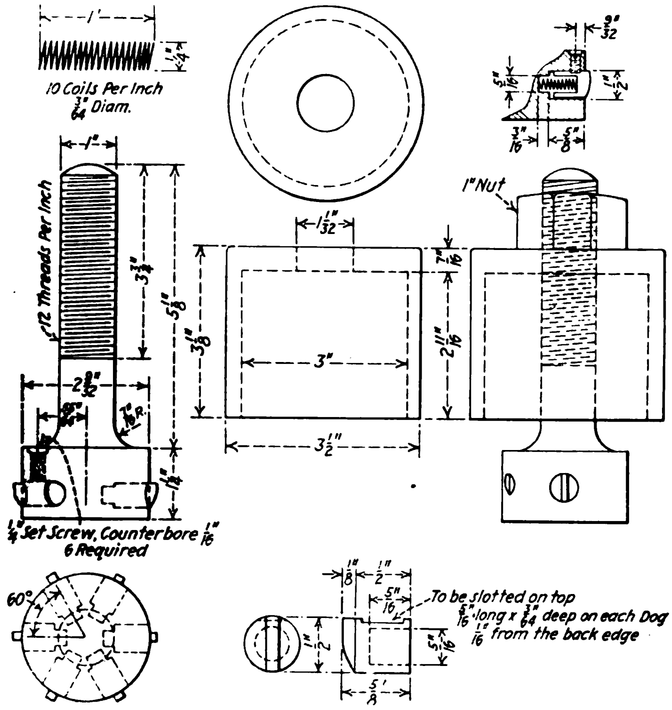
new or repaired parts are to be finished, allowance being made by the inspectors for the fit.

Another outstanding feature of the work in the machine shop is the extent to which special gages, fixtures, jigs, etc., are used to speed up the work.

(To be concluded next month)

Air pump bushing puller

In the top head of an 8½-in. cross-compound air pump is located a small bushing having six ports or openings. In dismounting these pumps for overhauling, it has been found quite a difficult job to remove this bushing without actually destroying it. While in many cases the bushing is not used again, nevertheless, to remove it either by boring out or chipping out involves a great amount of time. As a means of conveniently removing this bushing, the puller illustrated in the drawing accompanying this article will, no doubt, be of interest to mechanics engaged in overhauling these pumps. The bushing puller consists



Device for removing the bushing from the top head of 8½-in. cross-compound air compressors

essentially of three parts. The body of the puller, as may be seen, is similar in appearance to a plug gage, in the large section of which are located six dogs or latches set into the body in such a manner that, as the body of the puller is inserted in a bushing, these latches are forced back into their respective recesses against the pressure of individual springs. The upper portion, or spindle, of the puller body is threaded to take a nut of suitable size. The third part of the puller assembly consists of a cup washer so designed that the inside diameter and the depth of the cup are each slightly greater than the outside diameter and length of the bushing to be removed. In using this device, the body of the puller is inserted in the bushing and not greater than a one-sixth turn is given so that the six individual dogs or latches will spring out in the ports or slots in the bushing. The cup washer is placed over the spindle and rests on the body of the pump head. The nut is then turned down with a wrench and the latches, engaged in the openings in the bushing, pull it out into the cup portion of the washer.

Gage for quartering and checking driving wheels

By *W. C. Deibert*

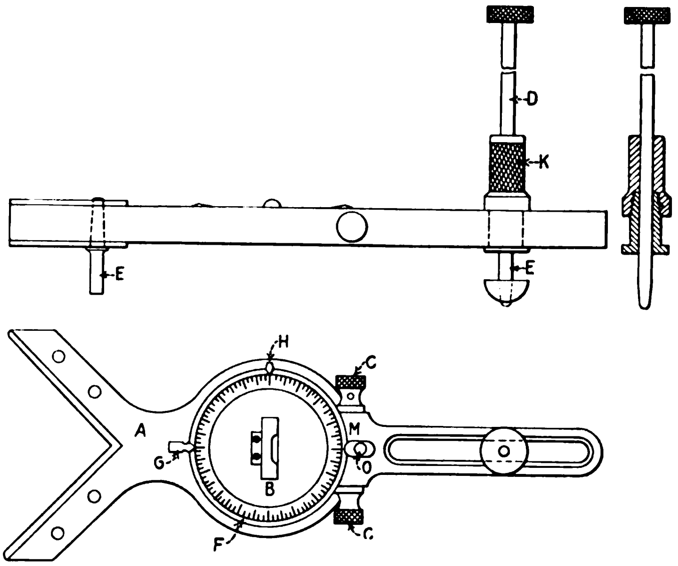
Toolroom foreman, C. & O., Clifton Forge, Va.

When a locomotive comes in the repair shop, one of the imperative jobs pertaining to wheel repairs is to check them carefully in order to determine whether or not the crank pin is in the proper location so that the valve motion events occur at the proper intervals. A quartering gage is the instrument commonly used for this work. The one shown in the illustration, because of its unique design, is well adapted for this class of work.

It consists of an aluminum body *A* and a dial *B* which is graduated to 90 deg. from either side. The dial is revolved by means of a worm gear which is operated by the knurled headed screws *C*. The vee-end of the gage is faced with hardened steel plates, while the slotted end is fitted with a steel bushing. The adjustable ball center *D* is long enough to reach the center of the axle even though it has entered a short distance in the wheel. The ball center *D* is locked in position by the knurled handle *K*. The two indicators *H* and *G* on the frame *A* are spaced 90 deg. apart. The dial *F* can be revolved to any desired position, and then locked by the clamp *M*. The two pins *E* are used to steady the gage and also to center the gage in the crank pin hole.

There are two methods of using this gage. The first is by the usual method of squaring up the wheels. The second is to quarter a pair of wheels regardless of where the pins are located.

When using the gage for the first method, the zero



Practical gage for use in the wheel or erecting shop

mark on the dial is set to the pointer *G*. The vee of the gage is placed on the crank pin with the pins *E* against the hub of the wheel, after which the ball center *D* is adjusted to the center of the axle. Then, by means of a block and wedge, the wheel is moved until the gage is level. All that is necessary now to place the gage in position for the other wheel is to raise the knurled knob *C* which lifts the worm free of the gear, and then move the dial *B* a quarter turn, and lock it in this position. As the gage is now set for the other wheel, place it on the wheel to be pressed on the axle and move it until the gage shows level and then press the wheel on.

With the second method, it is not necessary to square

up the wheels as they can be quartered with the crank pins in any position. The gage is placed on the wheel as before and the dial turned until level and the reading noted. If the reading, for example, should be 30 deg., the dial is moved back to the same reading on the opposite side of the zero mark and the reading taken at the point *H*. This reading is then moved back to the pointer *G* and is set for the other quarter. The gage is placed on the wheel to be pressed on the axle and moved until the gage shows level, which indicates that the wheel is ready to be pressed on. If the reading should be in a fraction of a degree, before moving the dial, the clamp *M* should be loosened and the ring *F* moved until the pointer *H* coincides with the first degree mark nearest to it. Proceed to set the dial as before, but using pointer *H* instead of the dial frame pointer *G*.

If it is desired to check up a pair of wheels, take a reading of each crank pin and add them together. If the two readings total 90 deg., the wheels are properly quartered and if the total does not equal 90 deg., either the wheels were not square originally, or the crank pins are worn. The gage will indicate the exact amount they are out.

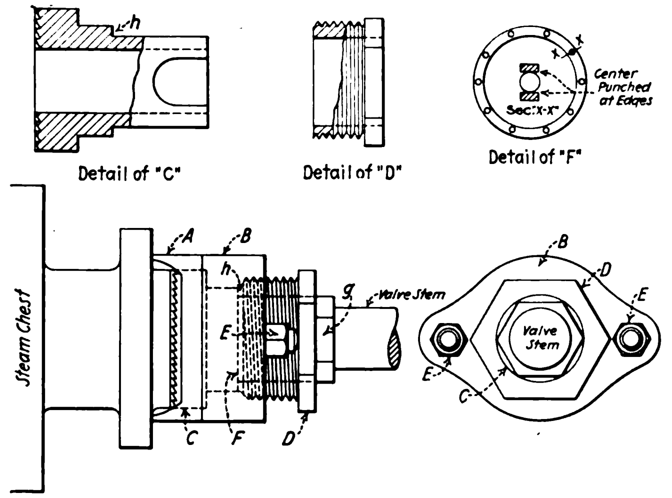
Reamers for facing steam chest stuffing boxes

By *V. T. Kropid*

Chief electrician, Winona Shops, Chicago & North Western, Winona, Minn.

IT often happens that the joint between the steam chest stuffing box and the packing gland develops a leak. In order to save time, a reamer was devised in these shops whereby the joint could be faced off while in place. It is only necessary to disconnect the valve stem from the rocker arm blade, remove the packing gland and slip on the reamer.

Referring to the sketch, the lower left hand view shows



Sketch of a reamer used for facing steam chest stuffing boxes

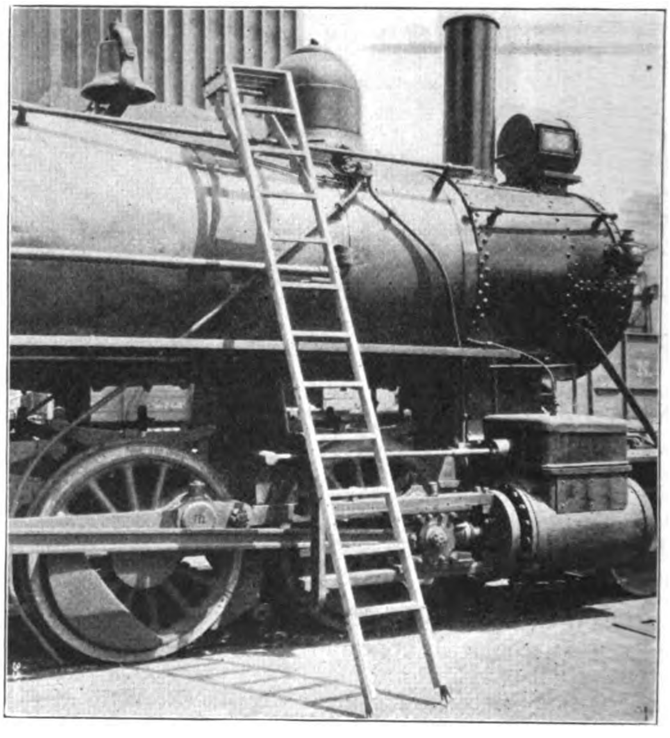
the application of the reamer to the stuffing box. It is slipped over the valve stem and secured with the same studs *E* that hold the packing gland in place. The reamer *C* has a hexagon shank *G* to which the operator applies a wrench for turning the reamer. Referring to the end view, *A* and *B* are two old style packing glands machined to suit this purpose. The part *A* is bored out large enough to go over the stuffing box, while *B* is bored to suit the shape of the reamer and is threaded to take the feed screw *D*. The feed screw *D* is provided with a hexagon projection for a wrench. There is a thrust bearing *F* which bears against the shoulder *H* of the reamer *C*, and against which the feed screw *D* pushes.

Details of *C*, *D* and *F* are shown in the sketch. The homemade ball bearing has ten 1/8-in. balls. The ring of this bearing is 1/8-in. thick and 1/4-in. wide and has ten 9/64-in. drilled holes. The balls are placed in the holes which are made smaller at the edges by center punching around the holes to keep the balls from falling out of the retainer ring.

We found this reamer to be quite useful when we adopted a new type of packing. Of course, in applying the new packing glands the stuffing boxes all had to be faced square to the new glands. With this device we could change the packing in the enginehouse without having to wait to have the stuffing box faced in the back shop.

A safe enginehouse ladder

MANY types of ladders have been designed for use around locomotives in shops and enginehouses. The common type of straight ladder, even when equipped with non-slipping feet is not always the most safe and convenient. The accompanying illustration shows the



A well-designed ladder for use in shops and enginehouses

design of a ladder used on the Detroit, Toledo & Ironton which embodies both the elements of safety and convenience. As may be seen, it does not differ greatly from a ladder of the conventional type except that it is equipped with three-pronged feet and the platform at the top. The feet may be made of 3/8-in. steel plate fastened to the ladder side-rails either by bolts or lag-screws. The diagonal braces supporting the platform are notched in several places to fit over the hand-rails on the locomotive. The proportions of the ladder and location of the notches are such that a man may safely stand on the top platform without the danger of the ladder slipping to the floor.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Cleaning the interior of freight cars

Buffalo, N. Y.

To the Editor:

I read with considerable interest the article on car department methods of cleaning the interior of freight cars, in your March issue. The method outlined is quite similar to that which we use in this territory. However, we have, a problem to solve which has given us more or less concern this winter. We clean and scrub the floors of freight cars in zero weather. The cars stand out in the open and considerable delay is experienced in getting them back into service because the floor does not dry. The first thing that we have encountered is ice forming over the wet part of the floor, which eventually melts and it is several days before the car is finally dried out. This, of course, depends entirely on the kind of weather we have while the car is in process of drying. During the drying period we are obliged to let the doors stand open to allow air to circulate through the car. But if it snows in the meantime, we get more moisture on the car floor.

Do you know of any good way of drying the cars that have been scrubbed, especially during the winter months when we have cold and wet weather to contend with?

A Reader.

One method of lubricating engine truck boxes

Battle Creek, Mich.

To the Editor:

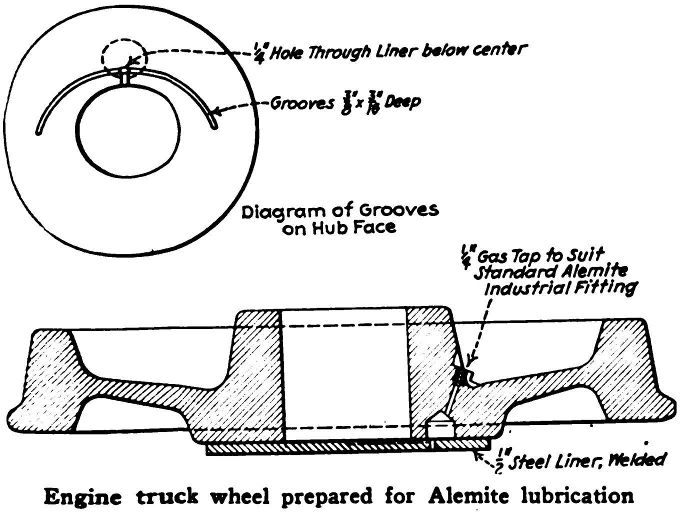
According to your editorial remarks in the February issue of the *Railway Mechanical Engineer*, considerable trouble is being experienced with hot engine truck bearings.

A year ago, the same trouble developed on a class of passenger power on the road by which I was employed. Care in the packing of cellars and the amount of lubricant used produces the same results—hot and scored journals. At the end of each trip, plenty of oil would be found around the outside of wheels and on the truck frames, but the bearings and cellar packing would be practically burned out.

After a careful investigation, it was found invariably that friction commenced at the hub followed by excessive heat, which was transmitted over the length of the bearing. To overcome this condition, an Alemite connection was applied in an accessible position on the outside of each wheel and the wheel drilled as shown in the accompanying illustration. A shot of grease, with an Alemite gun at each terminal, resulted in the elimination of hot bearings on this class of power. The grease, in addition to keeping the hub cool, acted as a stop to the oil from being drawn out of the cellar by the centrifugal action set up by the revolving wheel.

The trailing truck hubs are taken care of in practically the same way, only that the Alemite connection is applied to the outside of the box. A pipe through the box conveys the grease to the hub face.

"Perky."



Engine truck wheel prepared for Alemite lubrication

Gage for laying off driving box brasses

Portsmouth, Ohio.

To the Editor:

The March issue of the *Railway Mechanical Engineer* contained a question from one of your readers, who signed

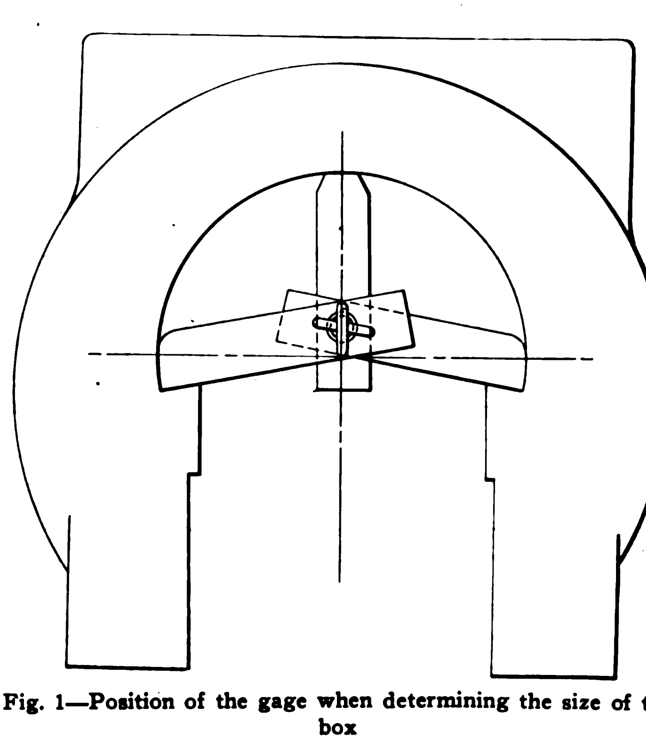


Fig. 1—Position of the gage when determining the size of the box

his name "A Constant Reader" wanting to know a good method of laying off a driving box crown brass for machining to fit in the box after it had been finished on the outside to the diameter of the box.

I have used several methods for doing this work and several different kinds of gages. The most simple gage I have ever used is the one shown in the accompanying illustrations. It is made of three pieces of 1/16-in. steel about 2 in. wide and 8 to 10 in. long, depending on the size of the driving box. A slot of suitable length is cut in each of the three pieces as shown. A screw, with a wing nut or a knurled headed bolt is provided for tightening the

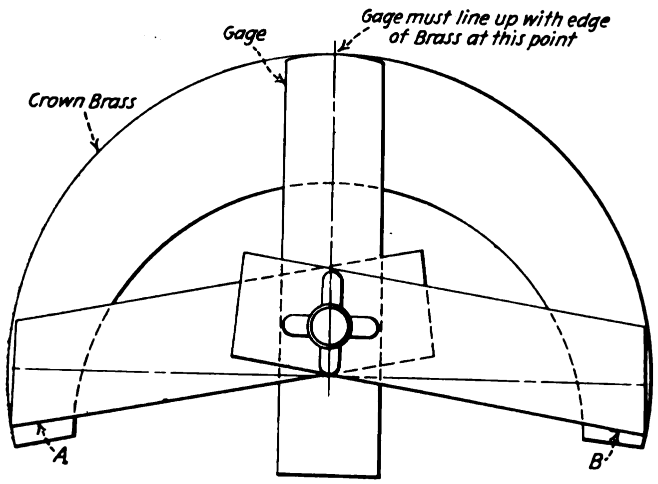


Fig. 2—Position of the gage on the crown brass when scribing the lines at A and B

gage after it is set to the size of the box as shown in Fig. 1. After the size of the box has been obtained by this method, the gage is removed and placed on the crown brass as shown in Fig. 2 and lines scribed at points *A* and *B* and the brass machined to these lines. With a little practice the machine operator can get the desired tonnage on the brasses by laying them off with a gage of this kind. This gage can be easily made in any shop or tool room.

J. H. HAHN,
Machine shop foreman, Norfolk & Western, Portsmouth, Ohio.

Puts the foremen on the defensive

Railroad Shop, U. S. A.

TO THE EDITOR:

After reading all that has been said by the railroad officials on the "Bill Brown" article, I decided it was time for some shopman to tell the "Top Sergeant" and other officials like him just where to get off at. From the way some of the articles read you would think a shopman—just because he punches a clock—is some animal who should just be fed and kicked around. I believe it is just that attitude of officials that causes all the trouble. It makes them contemptible to the man and the men therefore take every little thing up that they have a grievance for until they have so many that they strike. You can't get this efficiency you talk about just by changing machines and methods. If the foremen would spend as much time studying and analyzing their men as they do the methods and machines they would get somewhere, but men like the "Top Sergeant" and many others never think the man amounts to anything if he has a good new machine.

I am an average mechanic, work all the time and do good work, at least my work is never found fault with. I have many times suggested to the foreman what I thought was a better way to do certain things. Did I get any encouragement? I was told to never mind about those things. One time I made a jig to save myself a lot of labor and also time for doing the job. The foreman knew I was making it and when I got it on the machine I was enthused and got the foreman. He came around and when he saw it he said: "Take that thing off and if you spend any more time making stuff around here without first telling me I'll fire you." This was the same one who wouldn't listen to my other suggestions. I had worked out a model of this jig in wood at home and made the jig itself while my planer was working and kept my work up while doing it. I had to use surreptitious means to help myself and the company.

I often think foremen like to pick on men, for I know men who are good men and they don't dare look up from their jobs, while other fellows just do enough to get by with, which indicates that partiality and favoritism is shown by some foremen.

I tell you, you can't get anything out of a man by making him think you want to fire him every time you find him not hitting the ball. If the foreman is fair and square to a man he will do his best all the time, whereas if he is mean the man will only work when the foreman is watching him. This attitude is only true to human nature.

I have it figured out that many of the foremen think the men don't know anything but work and any suggestion that is made by a man is no good because the foreman didn't make it. A foreman shouldn't forget that he was once one of the "know-nothings" working at some job, and I'll bet he thought the same things then that we think of some of the foremen now, or in other words the foreman should not forget that he was once in the rank and file.

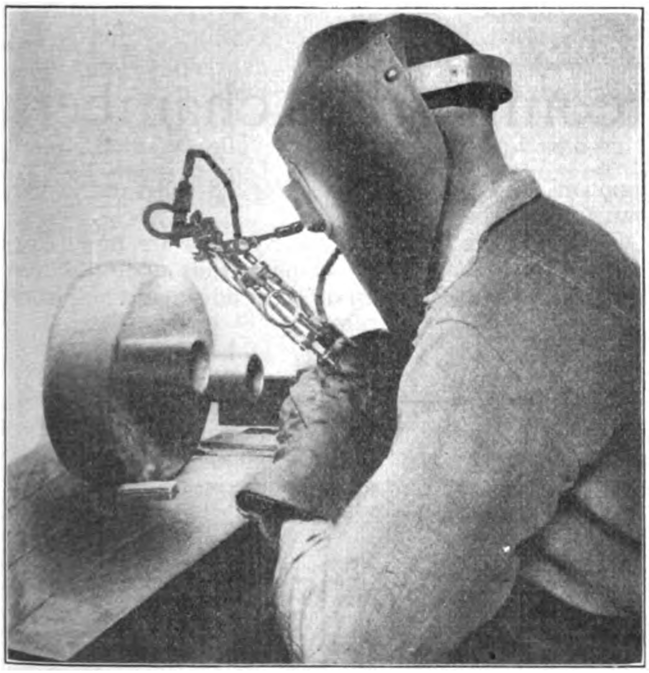
I don't want anyone to think I am dissatisfied with my job, but it could be made a whole lot more pleasant and I know the railroads would get lots more work out of the men. We have wives and children who like us to be pleasant and happy when home, but you can't have these things if every day at the shop you are getting bawled out for something or other. I would like more money, of course, but I realize that this isn't possible under present conditions and money isn't all. There are things a fellow can enjoy without money, if conditions where he works are pleasant. I belong to a labor union and always have, though I believe if the railroads would have a graduated scale of pay for mechanics—say from 50 cents per hour to 85 or 90 cents per hour, they would be doing a great thing. A man who was only getting 50 cents would always be studying, working and striving to be good enough and fast enough to pass the requirements for the higher rates. This would sure be an incentive and the railroads could help by holding classes for the men a couple of times a week. I'll bet every man in the shop would go. You could also grade them on the new ideas they have devised and when they were examined include the grade or merit on the rate. Would everybody then be thinking and working all the time? It is my opinion they would, for it is only natural for workmen to want to earn more so that they can give their families more of the luxuries of life.

I would like to have some other shopman answer the foremen's articles for I think these articles have given us a chance to present our side of the story, especially to the old "Top Sergeant" and those who believe in him.

ED. WOODS.

Atomic hydrogen arc welding process

FIFTEEN years ago, while studying the loss of heat of the tungsten filaments of incandescent lamps in an atmosphere of hydrogen gas, Dr. Irving Langmuir of the General Electric Company research laboratory at Schenectady, N. Y., found that at a high temperature the hydrogen gas changed from the molecular to the atomic

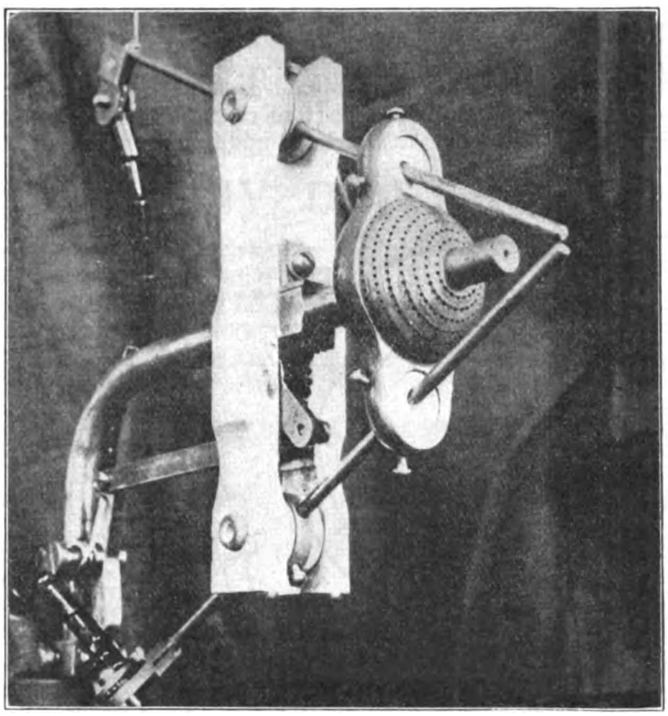


Welding with the atomic hydrogen arc

state. The molecular form is the more stable, and when the atoms recombine to form the molecules intense heat is liberated.

Continuing the theoretical investigation, Dr. Langmuir found that more atomic hydrogen was formed by passing powerful electric arcs between tungsten electrodes at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, the atomic hydrogen could be blown out of the arc forming an intensely hot flame of atomic hydrogen which, in resuming the molecular form, liberates about half again as much heat as does the oxy-hydrogen flame. In this flame molybdenum, one of the most refractory of metals, melts with ease; quartz, however, melts less easily, in spite of its lower melting point. This indicates that the metal assists in the action as a catalyzer (a substance which accelerates a chemical change).

By this method iron can be welded or melted without contamination by carbon, oxygen or nitrogen. Because of the powerful reducing action of the atomic hydrogen, alloys containing chromium, aluminum, silicon or manganese can be welded without fluxes and without oxidation. The rapidity with which such metals as iron can be melted seems to exceed that in the oxy-acetylene flame,



Atomic hydrogen arc welding torch, Type I

so that the process promises to be particularly valuable for welding.

The two electrodes of the torch are tungsten rods, held at an acute angle with each other by lava insulators. When not in use, the electrodes are in contact with each other;

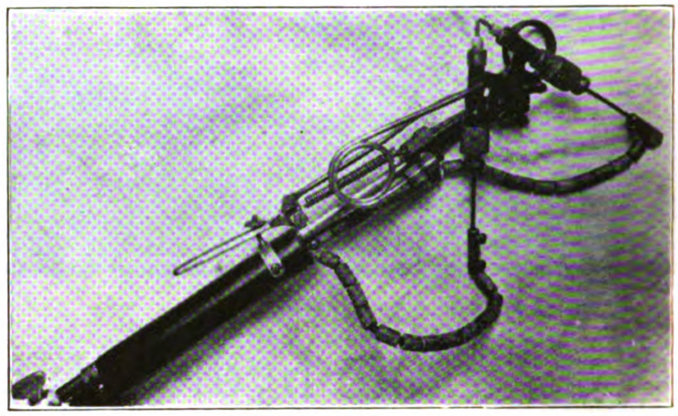
they can be separated by pressure on a lever mounted on the handle. A set screw is provided for making slow adjustments of the electrodes. The hydrogen is supplied by a tube through the handle. Sufficient gas is used so that not only are the electrode tips surrounded by enough gas to form the blast of atomic hydrogen but by an additional quantity to surround the work with hydrogen.

Either alternating or direct current can be used. The first mentioned has been found more convenient, and electrodes of smaller diameter can be used. The gas pressure required to operate the torch is very small; in the laboratory, with short lengths of tubing, a pressure of less than one pound per square inch was sufficient with metals up to one-half inch in thickness. For ordinary welding, the rate of gas consumption varies between 20 and 30 cu. ft. per hr.

Since the maximum rate of heating is desired in welding, the torch is held close to the metal. Best results have also been obtained when the torch is inclined so that the blast of hydrogen from the torch passes over the pool of molten metal in a direction opposite to that in which the torch is moved along the line of the weld. Experiments have been conducted with several gas mixtures and various electrode materials. The best results have usually been obtained with tungsten electrodes and hydrogen alone.

Materials of many kinds have been successfully welded by this method. Low carbon steels up to ½ in. in thickness have been welded without additional material after butting together tightly. Considerable work has also been done in connection with full automatic welding, using a butt joint and adding no metal to the seam. A number of welds have been made on seamless tubing having a wall thickness of ¼ in. and an outside diameter of 4 in., and with boiler plate one inch thick. Welds on deoxidized copper such as silicon-copper have been made on metal up to ⅜ in. thick, giving unusually good sections.

In testing welds made by this process, the welded portions have been twisted and bent double without cracking or otherwise being injured. Such a procedure has not been possible with the ordinary arc weld, since such welds are usually brittle because of the presence of nitrides or a thin film of oxide or scale, removed in the new process by the presence of hydrogen.

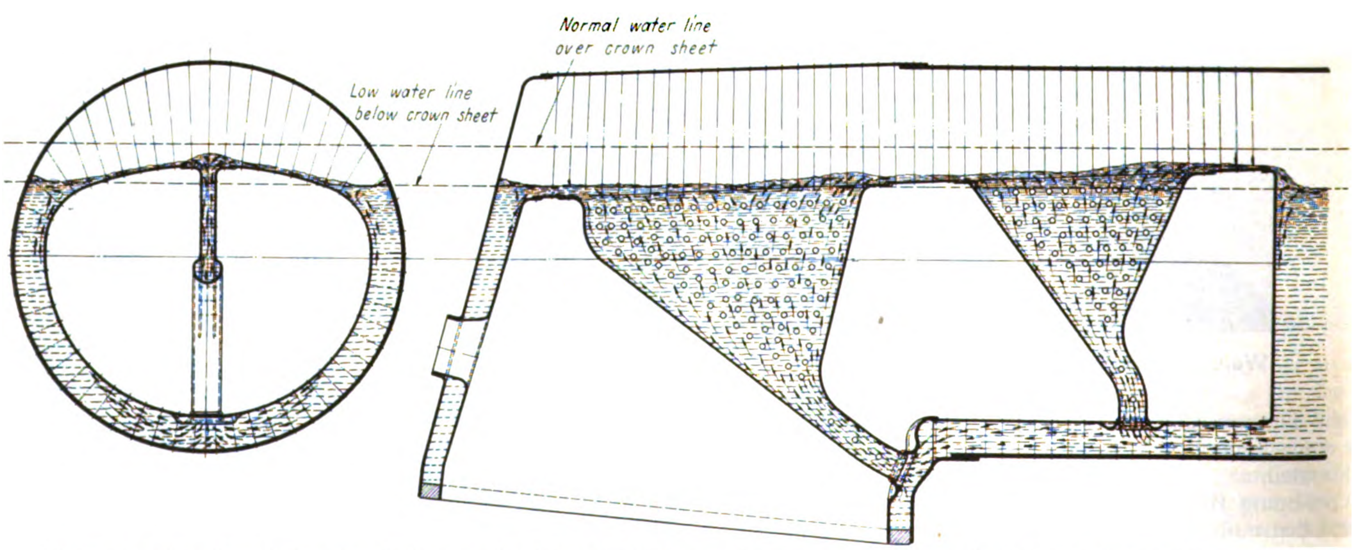


Atomic hydrogen arc welding torch, Type II

Thermic syphons used in combustion chambers

THE trend in locomotive boiler design has for years been towards proportionately larger grates and fireboxes in order to obtain greater capacity and more efficient transfer of heat from combustion gases to boiler water. One factor which, in addition to other important advantages, has contributed materially to enlarged firebox heating surfaces while taking but a small proportion of the total firebox volume above the arch, is the Nicholson Thermic Syphon and, to date, the Locomotive Firebox Company, Chicago, has placed in service Syphon equipment on 1906 locomotives for 78 railroads in this country and abroad.

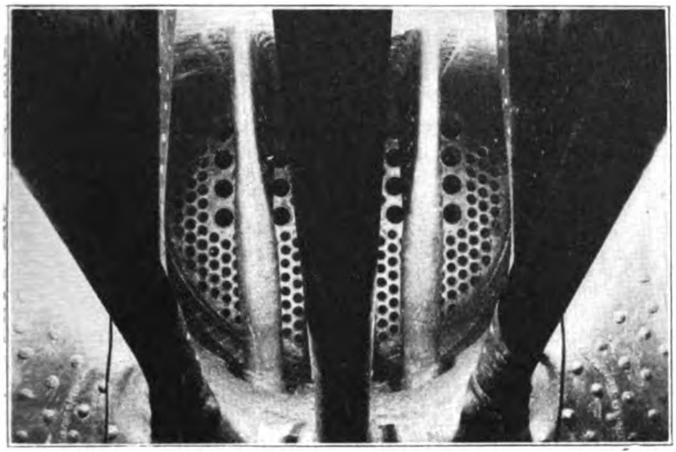
One or two units of Thermic Syphons are now being installed in the combustion chamber, thus adding to the heating surface in a location of great advantage but, more particularly, serving as a feature of additional protection in the event of low water.



View showing how Thermic Syphons stimulate circulation and protect the crown sheet in the event of low water

Thermic Syphons have prevented boiler explosions in several cases of low water, there being six definitely reported with water down from 3½ to 6

in. below the high point of the crown sheet. The pumping action of the Syphons in such cases causes the water to continue flowing from the Syphon opening over the crown sheet. This overflow serves to prevent general overheating of the sheet, which is further protected by the girder like support rendered by the Syphon. A small portion of the sheet ahead of the Syphon becomes heated, allowing one or more radials to pull through thus providing a gradual release of the pressure. Five of the above cases were on straight flue sheet boilers



Syphon installation with two units in a combustion chamber

with approximately 18 in. of space between the flue sheets and Syphons. A recent case of low water occurred on a combustion chamber boiler, Syphon-equipped, with a space of 43 in. between the flue sheets and the Syphons. Due to a larger exposed area of the crown sheet, 28 radials pulled through the sheet but no rupture occurred.

With the continued rise of the crown sheet, as in a combustion chamber design, it is a question of how long a chamber may be protected by a firebox Syphon. In the above case, the chamber was short, only about three feet, but many boilers have chamber lengths up to seven feet or more. By the addition of Syphons to the combustion chamber, an overflow effect, to protect the crown sheet in event of low water, is furnished in the same relation to location as on straight flue sheet boilers.

A combustion chamber application, in combination with the usual firebox Syphon, is shown in the drawing. Locomotives having this design modified to include two Syphons in the combustion chamber as shown in the photograph, are giving excellent performance.

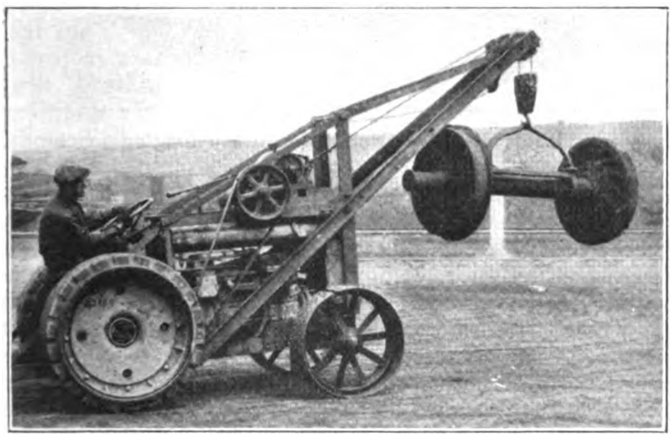
It will be noted that the same design as the firebox Syphon is used in combustion chambers, being generally triangular in shape; made of firebox steel, with a 3-in. width of water space; staybolted in the usual manner. It is welded to the crown sheet in a similar fashion and the lower attachment employs a standard diaphragm welded to the bottom of the chamber. The structure, therefore, becomes a strut or column between the top and bottom sheets of the chamber with a very long top bearing and a comparatively short vertical dimension.

It is a known fact that some difficulty in the maintenance of combustion chambers has been experienced since their inception, which may be due to slow circulation of the boiler water. One purpose of locating Syphons in the combustion chamber is to draw water from around the chamber and discharge it above the crown sheet, facilitating the general circulation. That such a strong upward current through such Syphons exists has been proved by water marks on plates especially placed over them for record.

Another advantage lies in the addition of heating surface. In the installation shown, the heating surface of firebox and combustion chamber is 329 sq. ft. The firebox Syphon heating surface has 90 sq. ft., an addition of 27 per cent. The Syphon located in the combustion chamber has 20 sq. ft., or 6 per cent more, a total addition to the firebox and combustion chamber of 110 sq. ft., or 33 per cent of heating surface. When desirable, two Syphons can be applied to the combustion chamber, making a total of 39 per cent.

Hoist for handling railway material

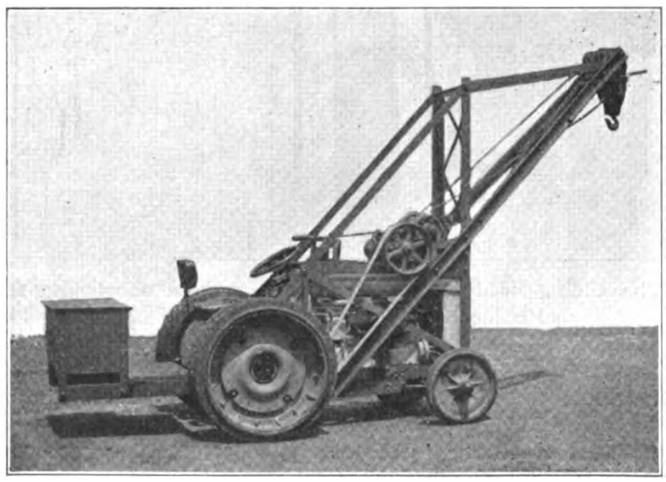
The hoisting unit shown in the illustrations is adapted to hoisting, loading and stacking stores material at store rooms, carrying materials from store rooms to locomotive shops and enginehouses, carry-



Lifting and carrying a pair of car wheels

ing the loads on the hoist boom or loading trailers and pulling the trailers to their destination and then unloading them. It is known as the Rix Fordson hoist and has been placed on the market by the Squier-Rix Company, 373 Broadway, Milwaukee, Wis. Simplicity of construction characterizes this hoist. It is designed to fit on the Fordson tractor without the necessity of drilling holes or in any way altering the construction of the tractor.

The boom structure is of a rigid bridge construction



The hoist, with loaded ballast box and wheels, has a capacity of 3,000 lb.

designed to take care of swinging load streses which occur when the equipment is moving suspended loads. The boom elevating mechanism is of the regular double pulley and cable type. It is equipped with an 8-in. by 8-in. drum which will hold 100 ft. of 5/16-in. cable. The regular equipment includes 45 ft. of 5/16-in. flexible cable.

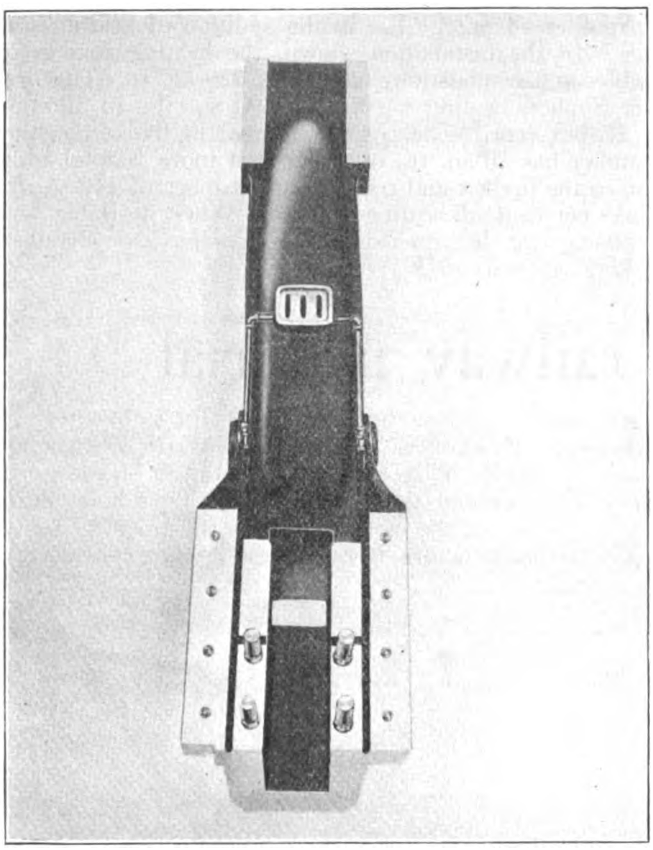
An automatic load brake which is standard on electric cranes is incorporated in the hoisting mechanism. This brake engages the load instantly when the power is released, preventing any possibility of the load dropping.

A limit switch is incorporated in the mechanism to prevent over-hoisting. The purpose of this device in a short lift portable hoisting unit is to insure the equipment and property against the forgetfulness of the operator in handling the control lever. This switch automatically throws out the control when the load is raised to the maximum height. An 18-in. by 18-in. by 2-ft. 9-in. ballast box is placed on the rear frame to add to the carrying capacity of the hoist. If not used for this purpose, it will serve as a tool box. The capacity of the unit is about 1,500 lb. when equipped with standard Fordson wheels and the loaded ballast box. The loaded ballast box, together with loaded and weighted wheels, will give the unit a carrying capacity of approximately 3,000 lb. The hoisting mechanism itself is designed and built for a maximum capacity of two tons.

This hoist is operated by means of one lever conveniently located near the operator's seat. It is built with lifts of 5 ft., 8 ft., 10 ft., and 14 ft., which gives a wide range of lifting heights for various services. The hook travel of the hoist is 23 ft. per minute. Ten horsepower of the capacity of the Fordson tractor is required to hoist and lower the maximum load.

National high duty forging machines

THE features that have been added to the forging machines manufactured by the National Machinery Company, Tiffin, Ohio, has so increased their capacity, weight and speed of operation that they are now rated as high duty machines. The essential features of the National forging machine design have been retained,



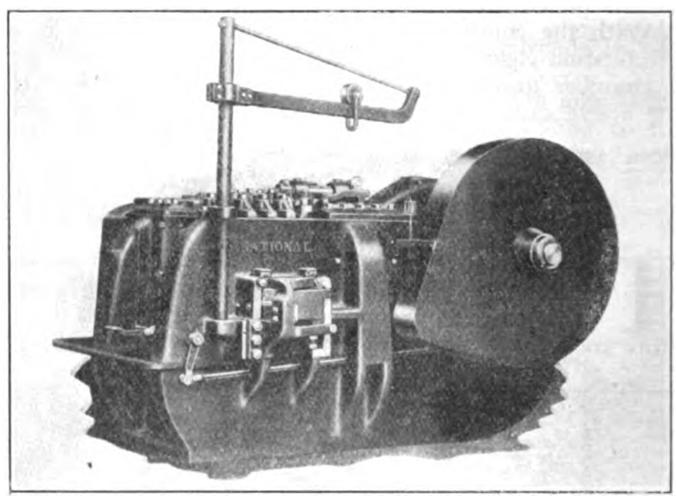
The sliding head has been designed without shortening the tool holder slot, or without an increase in the length of the bed frame

including the short and compact underslung bed frame; the suspended type heading and gripping slides; the patented automatic grip relief; the wedge type liner adjustments for the heading and gripping slides, and the friction-slip fly wheel.

The bed frames have been increased in depth and weight, thus giving a heavy type C clamp bed frame. This imparts a degree of rigidity which prevents the springing open of the bed frame, thereby eliminating swollen shanks, excessive fins, etc., on the forgings. This rigidity also prevents the work from slipping through the dies, and practically eliminates the necessity for back stops.

The compact bed frame design was made possible by the adoption of a new type over-arm heading slide which has only a part of its necessary length at the customary location ahead of the crankshaft, thus allowing a great reduction in the length of the bed.

Another improvement consists of a redesign of the

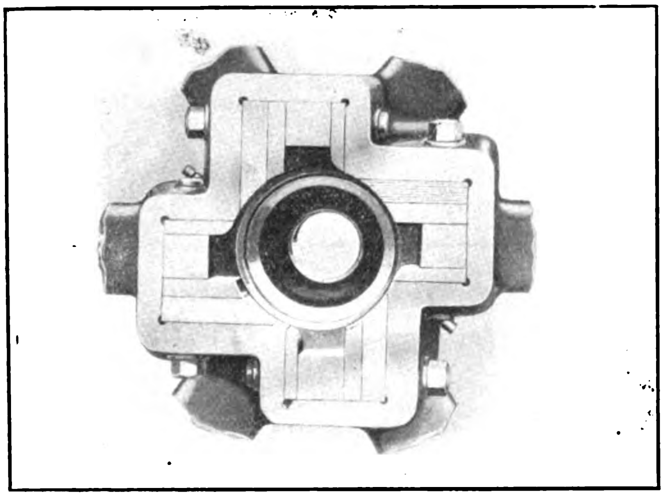


A front view of the National high duty forging machine

heading and gripping slides, providing them with over-arm or extended bearings, which serve to increase greatly the accuracy of the slide alinement. The heading slide, has been designed without shortening the tool holder slot, or without an increase in the length of the bed frame. This over-arm heading slide guides the heading tools with accuracy and freedom from side movement which allows more unsupported stock to be successfully gathered in one blow than on the older type of machines.

The grip slide has also been provided with an extended under-arm which prevents both sagging and rocking of the slide. By maintaining absolute uniformity of grip slide alinement, the grip dies can effectually grip the work through their entire length, thus preventing the work from slipping; and as the dies cannot rock or wobble,

there are no swollen shanks or excessive fins along the body or under the head of the forging. The customary knuckle block at the front end of the heading crank pitman has been replaced by two bronze bushed bearings in the cheeks of the heading slide, which operate in connection with a large round pin gripped in the front of the heading pitman. This has greatly increased the bearing area, and is claimed to have eliminated the trouble from wear, caused by scale and dirt getting into the knuckle bearing..



Quadruple abutment starting clutch

Among other improvements is an increase in the depth of the die space, and as this increase has been made entirely below a center line passing through the crankshaft, it is now possible to use much higher dies than heretofore, without any tendency for the heading slide to raise out of its bearings. The dies can now extend considerably above the top of the grip slide and bed frame, without danger of the slide raising and breaking the slide caps, heading tools, etc., as in the other types of machines. This increase in the die capacity has greatly increased the range of work that can be handled upon these machines. Another point of considerable interest is that the length of the heading slide enables the downward pressure from the heading crank pitman to hold the front end of the slide in a down position, thereby resisting any tendency for the slide to raise when the work is above the center line. In the old style machines, with the slides entirely ahead of the crank connection, any pressure on the heading ram above the center line invariably raised the slide and accounted for the breakage of small diameter heading tools, punches, etc.

These machines are equipped with the customary National suspended type heading and grip slide bearings, which place the bearings above the path of scale and water; and all have the wedge adjustment at the side of the slides, so that merely by removing the top cap any side play can be removed without the necessity of removing the slides from the machine.

These machines are also equipped with the new quadruple abutment starting clutch, which causes the machine to start in one-quarter of a revolution. This gives practically instantaneous starting, resulting in a marked increase in output, and, in many cases, the elimination of a reheat on jobs requiring a number of blows.

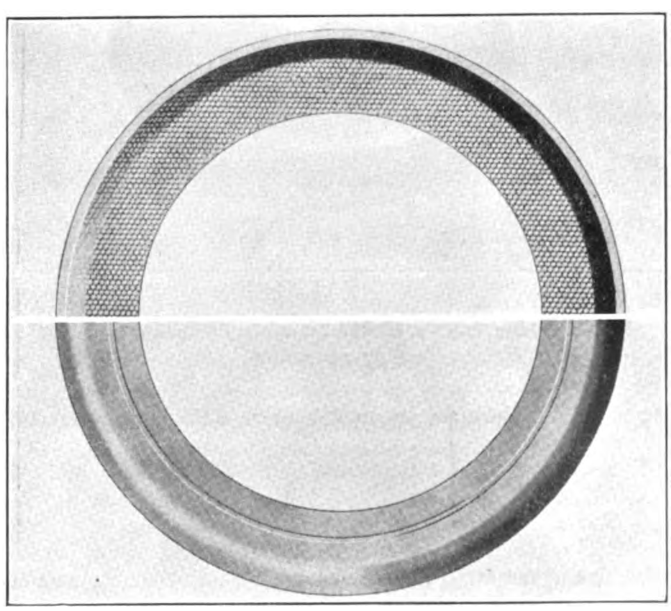
Another improvement has also been made in the design of the clutch mechanism. The clutch pin is now a large rectangular member having a large bearing area. It travels in a pocket in the hub of the crankshaft, and engages the hardened clutch abutment blocks in the main gear, which in turn are backed by laminations that cushion the starting movement and eliminate wear.

These machines are built in 2-in., 3-in., 4-in., 5-in., and 7½-in. sizes. They can be either belt or motor gear driven, using the friction-slip flywheel as the necessary safety for the motor.

Packing cup meets tests

The Committee on Brakes and Brake Equipment of the Mechanical Division, American Railway Association, has recently unanimously approved the report of a sub-committee recommending that the Kendall brake cylinder packing cup be recognized as standard A. R. A. brake cylinder packing and a price listed for it in the interchange rules. This decision was reached as a result of extensive tests on the Chicago & North Western, the Chicago, Rock Island & Pacific, and the Illinois Central. Following each leakage test, the air brake cylinder piston was removed and an examination made of the packing leather. It was noted that packing leathers in service for the longest periods of time had developed a more highly polished cylinder bearing than those of more recent application indicating that the life of Kendall cups will be of indefinite but long duration. Repair men in all cases were interviewed and the committee was informed that it has never been necessary to remove a Kendall pocking cup for any reason, nor has any difficulty been experienced in the initial application of these cups. Cars involved in the tests were selected at random, and no extra precautionary measures taken to improve conditions prior to the tests. There were instances when packing cups bore indentations, leaving but a narrow strip of bearing area, but even under these conditions the maximum leakage was but four pounds a minute.

The Kendall brake cylinder packing cups, some of which have been in service since 1921, consist of an outer cup member of krome leather with an inner cup member of

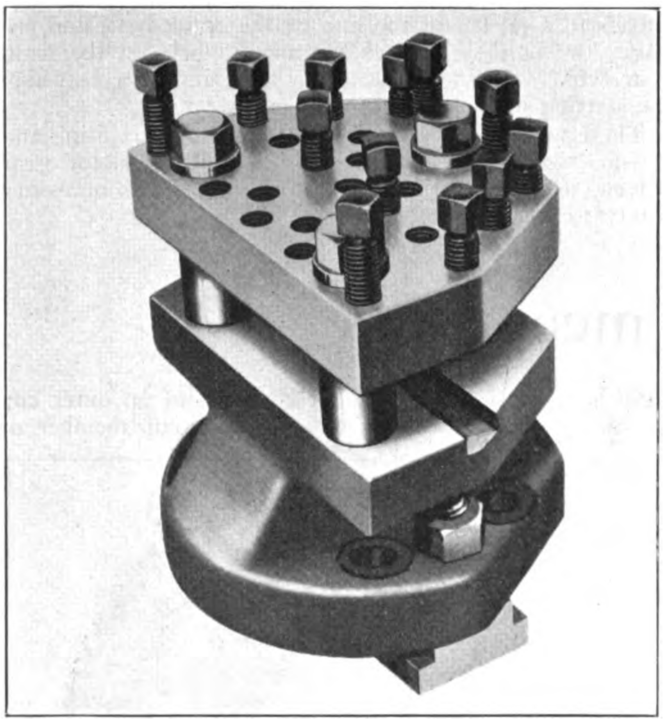


Kenaall brake cylinder packing cup which is used without expanding ring

canvas or other similar textile fabric firmly united by a cement which makes the cup impervious to air. With this method of manufacture, the cup is sufficiently rigid to retain its shape when attached to a piston head and to maintain close contact with the inner face of the cylinder without the use of an expander ring. Easy application, durability, reduction of air leakage, and freedom from cracks and breakdowns due to temperature changes, moisture, or the use of any standard brake cylinder lubricant, are features claimed for this new cup, which is made by the Air Brake Cup Packing Company, Chicago, and sold by the Gustin-Bacon Mfg. Co., Kansas City, Mo.

Universal tools for turret lathes

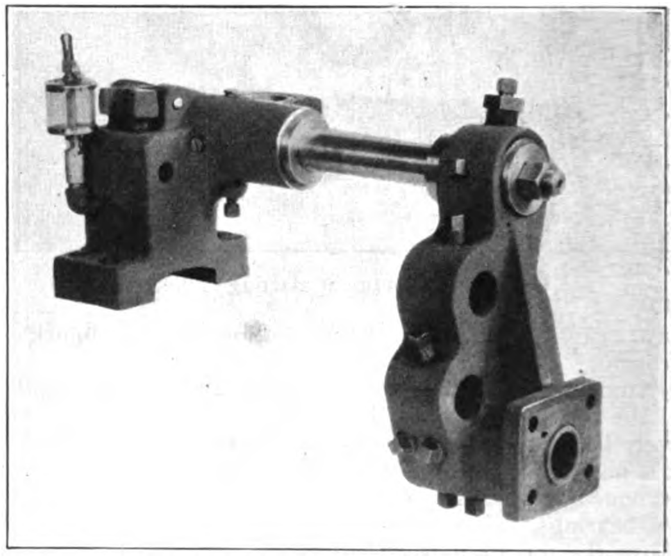
THE Warner & Swasey Company, 5701 Carnegie Avenue, Cleveland, Ohio, has developed a new series of tools designed for making multiple and combined cuts for use in connection with its Nos. 1, 2, 4 and 6 turret lathes. The following is a description of the multiple turning head with overhead pilot attachment; multiple cutter holders; off-set cutter holders and the cross slide cutter blocks. The multiple turning head with an overhead pilot adjustment is a tool particularly adapted for small and average lot work of medium or heavy type. Since with this tool heavy feeds may be taken without using special pilot bars, the overhead pilot bar, which has a radial adjustment to compensate for wear without sacrificing rigidity, is supported in the multiple turning head by four screws giving a four-point bearing for alinement with a bushing on the head of the machine. This is a patented feature. After proper alinement is secured, the bar is firmly clamped by means of a washer and nut on the rear end.



The universal cross slide cutter block eliminates the necessity of making special blocks on multiple facing and forming operations

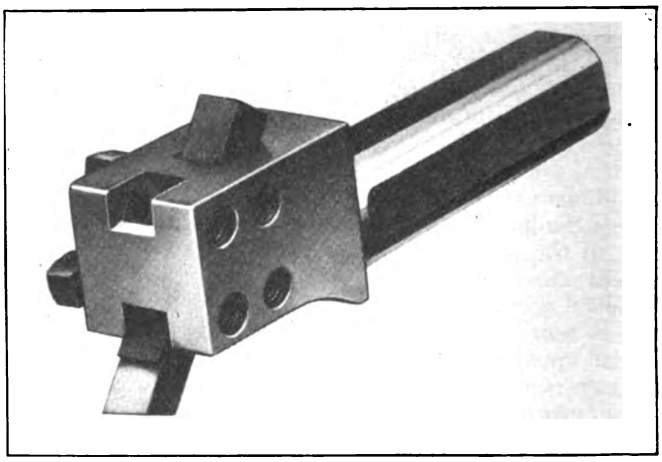
The overhead pilot bar passes into a bracket which is attached to the front of the head. The adjustable bushing, also a patented feature, makes it possible to attach the bracket to the machine when not in use. Only one bracket and bushing are required for each machine as the pilot bar of each multiple turning head is adjusted to this one bushing. The multiple turning head itself contains holes located at different distances from the center, giving an extensive turning range. Various cutter holders of different styles are used for turning, boring, facing and chamfering.

Forged boring cutters may be held in the center hole by using the rocker bushing shown. The center hole may also be fitted with stub boring bars, drills, reamers, pilot bars and similar tools. The head itself is heavy and rigid and is designed to afford suitable tool clearances.



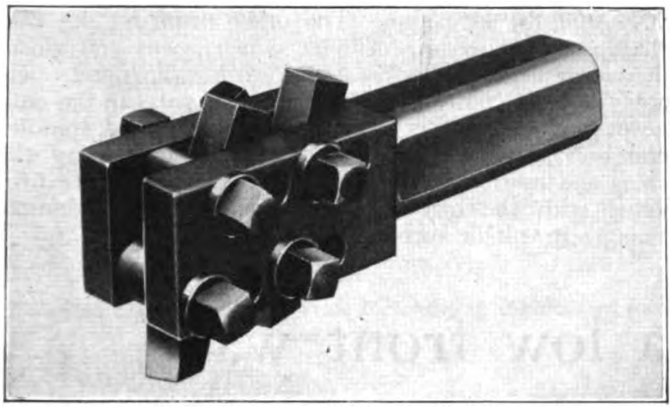
Warner & Swasey universal multiple turning head with overhead pilot attachment

The multiple cutter holder is for use in the multiple turning head just described. The holder carries two cutters which are adjustable to different positions for turning two diameters at the same time, or for turning and facing. Tie screws and bushings are furnished to prevent the



The off-set cutter holder is designed to provide maximum support for the cutters

slides from springing apart when clamping the cutters. A variety of holes makes it possible to shift these to different positions for a wide number of combinations of tools. The holders may be moved in and out of the heads



The multiple cutter holder may be used for turning two diameters at the same time or for turning and facing

for the length of the cut. The entire holder is hardened and the shank is ground and flatted.

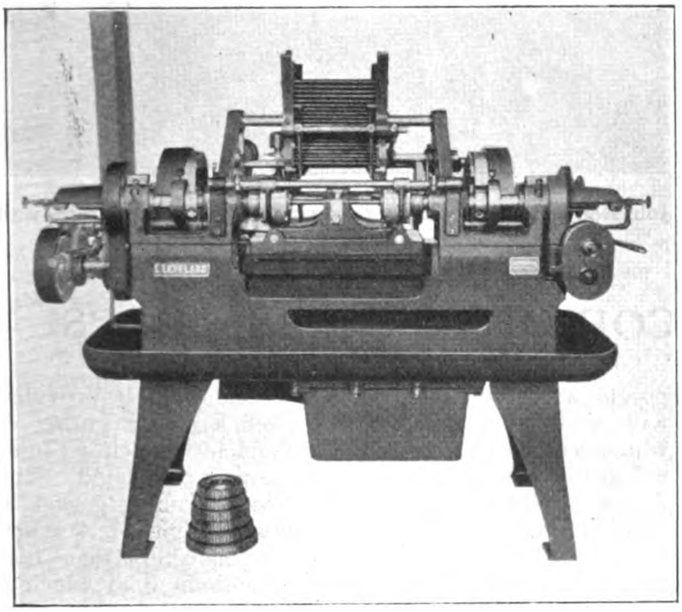
The off-set cutter holder is also used in the multiple turning head when the cutter would project too far if used in the straight or angle cutter holders. Better support is given to the cutters, particularly when using stellite. Slots for the cutters are grooved from the solid, leaving tie pieces between the sides of the holder to prevent them from springing.

The holder is moved in and out of the heads for the length of the cuts. The cutter is held by two screws. The entire holder is hardened and the shank is ground and flatted. Often when two diameters of different sizes must be turned and bored, this tool is desirable to reduce the overhang of the cutters by stepping down and stepping up with these holders.

The cross slide cutter block is a tool designed to eliminate the necessity of making special cutter blocks and cutters for each individual job when performing multiple facing and forming operations on the cross slide. These cutter blocks are available either for the front or rear, the rear block being higher than the front one. It is possible to set each block in four different positions on the cross slide and by different arrangements of cutters in each of these positions, a great variety of combinations can be obtained. Inexpensive forged cutters may be used so that when it is desired to change from one job to another it is necessary only to regrind and set the cutters. This cutter block is of heavy rigid construction and made entirely of steel.

Double end stud and pipe nipple threader

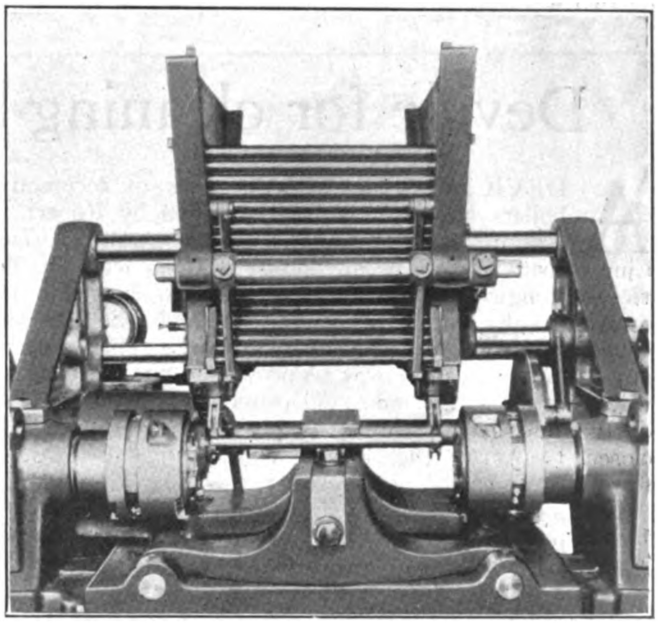
A NEW machine, designed for the production of work requiring double end operations such as the threading of pipe nipples and studs, has recently been placed on the market by the Cleveland Automatic



Front view of Cleveland double-end stud and pipe threading machine

Machine Company, 2269 East 65th street, Cleveland, Ohio. In the design of this machine, which is known as the Model "J" the manufacturers have departed from the usual custom of revolving the work while the tools remain stationary, and have arranged the machine to rotate the tools and carry them on to the work which is held in a stationary center chuck. This model is manufactured in two sizes, one for threading pipe nipples up to 2 in. pipe size and for studs up to 1½ in. diameter, the magazine handling lengths from 1½ in. to 14 in. The smaller size will thread pipe nipples up to ¾ in. pipe size and studs up to ¾ in. diam.—the capacity in length being from 1½ in. to 12 in. In addition to pipe work, steel, brass and cast bars as well as steel and brass tubing within the capacity range can also be handled.

The machine is equipped with a Cleveland hopper magazine located in the center, which is arranged with oscillating levers, timed from the cam shaft to control the dropping of the parts to sliding conveyor fingers which



Close-up view showing the arrangement of the adjustable hopper and feeding machine

carry each piece to an air-operated floating center chuck. Power is supplied by either a single pulley belt or motor drive and is controlled by a hand lever operating a clutch in the driving pulley. The tool feed is engaged or disengaged by a hand lever. The machine may be turned over by hand by means of a crank on the shaft to the left of the tool feed hand control lever, thus providing complete control of the machine.

The machine is equipped with a special safety device which is regular equipment on machines manufactured by this company. This functions by shearing off a pin in the worm-gear drive, causing the feed to stop, thereby preventing damage to any part of the machine or tools in the case of the accidental jamming of tools. This safety pin is easily replaced and the machine is ready to operate. The tool feed to the two tool spindles is furnished through cams mounted on the circumferences of two drums on a cam shaft. Cams on the side of one of the tool feed drums furnish the action for operating the finger conveyors in the magazine. The other drum on the cam shaft operates the air cylinder which opens and closes the center floating chuck. A disk on the cam shaft operates the lever controlling the feeding of parts to the conveyor fingers. Oil is carried through the two spindles and dies in a constant stream which clears away the chips and lubricates the chasers. Change gears are provided with the machine which will permit of ample changes in spindle speeds.

Rivet forge with a low front wall

THROUGH experience, the engineers of the Johnston Manufacturing Company, Minneapolis, Minn., found that the high front walls of portable rivet forges are unsatisfactory as the rivets which dropped behind this wall were nearly inaccessible because of the gases blown out through the charging opening. This undesirable feature is overcome by making the front wall only 2 in. high in the new No. 15 portable rivet forge recently placed on the market by this company.

In this forge a large proportion of the gases is discharged through a vent at the left rear corner of the chamber and only a small part passes through the charging opening. The gases coming out through the charging opening are, moreover, held back by an air curtain. This curtain is of a new type which contains large holes but is so arranged that it is said to use only a small amount of compressed air. The forge is equipped with the Johnston non-clogging vacuum burner, which has been described on page 501, in the August, 1924, issue of the *Railway Mechanical Engineer*. The lining of the forge is of a good grade of firebrick, set in high temperature cement. Owing to the quality of the material and the uniform heat produced by the burner, it is claimed that the lining will last until the floor of the forge is worn out by the handling of rivets. The machine can be easily carried by two workmen.

Johnston portable rivet forge designed with a low front wall

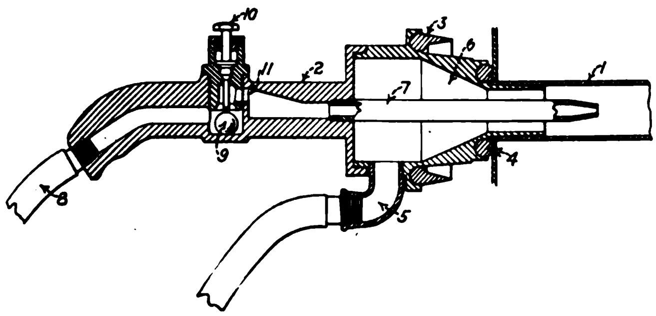
Device for cleaning locomotive boiler tubes

A DEVICE for cleaning the flues of locomotive boilers has recently been patented by Robert D. Kilcrease, enginehouse foreman, Atlantic Coast Line, Albany, Ga. The method of cleaning with this device, a longitudinal section of which is shown in the drawing, is by forcing a cleaning fluid into the flue with compressed air from the shop air line. The principal object of the inventor was to provide a flue cleaner that would force the dirt and cinders out of the opposite end of the flues in case it was not entirely closed, and if closed, to prevent the cleaning compound and dirt from flowing back on the man doing the cleaning.

Referring to the reference numbers on the drawing, 1 is a portion of the boiler flue next to the flue sheet. The flue cleaner comprises a tubular body 2, one end of which is turned down for a hose or flexible coupling 8, to be coupled to the body. The body is expanded as shown in the drawing and the head of the cleaner is screwed into it. The forward part of the head forms a nozzle which fits into the flue. The head is provided with a shoulder in which is seated a rubber gasket 4, which bears against the flue sheet and forms a closed joint which prevents leakage of the cleaning compound. The device is also provided with a second rubber gasket 3, which performs a function similar to gasket 4 when cleaning flues or tubes of larger diameters than that shown in the drawing. The elbow joint 5 to which a hose or flexible coupling can be attached is the outlet through which the cleaning compound, scale and dirt can escape from the enlarged chamber in the head when backed up on account of the flue being choked.

The flow of cleaning compound which is forced through the hose 8 is controlled by the valve 10. It will be noted that the inlet and outlet parts of this valve are not in alinement. The inlet part leads into a chamber in which is a ball 9. The stem of the valve 10 rests on a plunger which seats by its own weight. The ball 9, of course, can also drop to the floor of its chamber by its own

weight. When the cleaning compound under pressure is admitted to the ball chamber, it lifts the ball against its seat and at the same time raises the plunger. The ball is thus held by the pressure of the fluid until the device



Longitudinal section of a device for cleaning the flues of locotive boilers

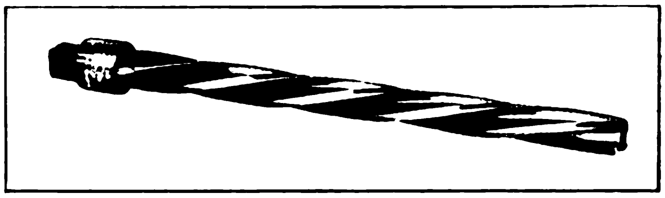
is ready for operation. When ready, the operator presses down on the handle of the valve 10 which depresses the plunger and forces the ball 9 from its seat, allowing the cleaning compound to flow through the port 11 and escaping with considerable velocity through the nozzle 7. If the flue is not completely closed by the accumulation of cinders and other particles, the force of the cleaning compound will carry the accumulations out through the opposite end of the flue. If the flue should be completely choked or nearly closed, the pressure of the fluid should be sufficient to dislodge the particles. Any back pressure created carries the loose particles through the outlet 5. This arrangement prevents the dirt and fluid from flowing back on to the operator which relieves him of considerable annoyance.

The body of the flue cleaner is shaped so that it forms a convenient handle which may be comfortably gripped by the operator. The design of the valve 10 is such that it is easy to operate, only a slight pressure on the handle being required to permit the cleaning compound to enter the flue with considerable force. The operator may also stop the flow of the cleaning compound by removing the pressure on the valve handle in case he desires to observe the progress of the work or to move to the next flue. This flue cleaner is designed to operate most effectively with from 70 lb. to 130 lb. pressure.

Celfor high speed locomotive frame reamer

CELFOR high speed locomotive frame reamers are now manufactured by the Clark Equipment Company, Buchanan, Mich., to the specifications adopted by the American Railway Tool Foremen's Association at its meeting in Chicago in September, 1925. The four flute reamers are made by the hot twisted process; the six flute reamers are milled. The standard practice calls for 1/16 in. taper to the foot, but any taper desired can be furnished. The reamers have a left hand spiral of 12 to 22 deg. depending on the size; square shanks or tapered shanks are also furnished.

The flutes are machine ground on the cutting edge which can be relieved with either a double or eccentric relief. The reamers are recessed under the head to pro-or from a 10-hp. constant-speed dust proof motor.



Reamer designed according to the specifications adopted by the American Railway Tool Foremen's Association

Motor driven 36-in. by 36-in. crank planer

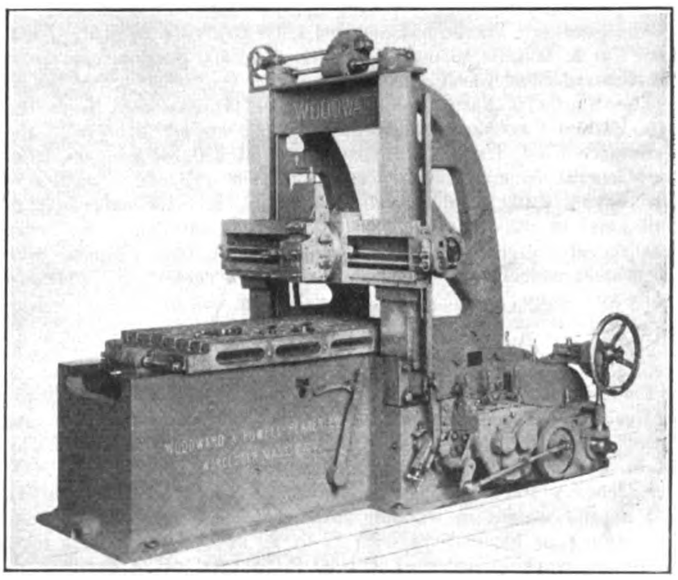
THE 36-in. by 36-in. crank planer, illustrated, has been added to the line manufactured by the Woodward & Powell Planer Company, 97 Webster Street, Worcester, Mass. The maximum stroke of the machine is 42 in.

The table is of box form and the work can be placed anywhere on it to come under the tool. The table drive is through a herringbone pinion and gear and a slotted rocker mechanism. The pin on which the slotted rocker oscillates is supported at both ends.

The design of the housings is uniform with that of the other machines in this company's line of planers. The housings are of box form and extend down over the side of the bed where they are bolted. The head is of the same size and design as that used on the company's standard, rack-driven, 36-in. planer. It has the usual horizontal, vertical and angular feeds either by power or by hand. The cross-rail has power elevation. A side head can be furnished if desired.

Six changes of speed are furnished on this model. They are 6, 8, 12, 17, 24 and 34 strokes per min. The changes are made through sliding gears mounted in a gear box at the front of the machine. The length of stroke is changed by means of a handwheel located on the operating side of the machine. A dial adjacent to the handwheel indicates in inches the stroke.

The machine can be driven from a single pulley belt or from a 10-hp. constant-speed dust proof motor.



Woodward & Powell 36-in. by 36-in. crank planer

PROMOTIONS AND APPOINTMENTS — I.C.C. — THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS — NEW TRADE PUBLICATIONS — NEW SHOPS

The Austrian Federal railways have invited tenders from domestic locomotive builders for 30 express, 100 passenger and freight, and 50 switching locomotives, valued at $3,500,000. These are to replace 555 old engines, whose cost of upkeep is estimated at $800,000 annually.

Safety Committees of the Southern Pacific received from employees during 1925 a total of 4,469 suggestions designed to correct unsafe practices and conditions. Of these suggestions 3,248 were adopted. A total of 1,184 foremen in charge of work crews established records of complete freedom from reportable accidents throughout the year.

The combined forces of the purchasing and stores departments of the Bangor & Aroostook gathered at Derby, Me., on February 16 for an inspection of the principal shops and general storehouses of the company, after which they were entertained at a banquet in the company hotel where several of those present, including C. D. Baldwin, purchasing agent, spoke on various phases of the purchasing and stores work. The event is the first of its kind in the history of the road and is expected to become an annual affair.

The locomotive shops of the New York, Chicago & St. Louis at Frankfort, Ind., were mostly destroyed by fire on March 9; estimated loss, including damage to locomotives, $500,000 or more. The fire is said to have started from an "oil burner" in the roundhouse. The enginehouse was a new one. Press reports say that about 600 men have been temporarily thrown out of work. Plans are now being prepared for the construction of a machine and blacksmith shop at this point to replace the structures destroyed.

Colonie car shops break safety record

The car shops of the Delaware & Hudson at Colonie, N. Y., employing approximately 475 men, on March 7 completed two years without having a reportable injury among its employees. This means that the men worked almost 2,000,000 man-hours without any individual losing more than three days, due to injury suffered while in the performance of his duties. This is believed to be a world record in this respect and is to be commemorated in a suitable celebration on Monday evening, April 12.

Freight car orders

The Southern Pacific has ordered 1,100 box cars from the Pullman Car & Manufacturing Corporation and 500 gondola cars from the Pressed Steel Car Company.

The Southern Railway has ordered 1,500 box cars from the Mt. Vernon Car Manufacturing Co., 1,000 hopper cars from the Tennessee Coal, Iron & Railroad Co., and 250 ballast cars from the General American Car Company. The railroad company is also having 2,100 gondola coal cars rebuilt and 100 caboose cars built, and in its own shops is building 500 flat cars. An order was recently given to the Virginia Bridge & Iron Company for 1,000 steel underframes to be applied to box cars in the Southern Railway's shops.

Southern Railway orders 113 locomotives

The Southern Railway has ordered 46 heavy Mikado type locomotives with 27 by 32 in. cylinders and a total weight in working order of 325,000 lb., 5 light Mikado type locomotives with 22 by 28 in. cylinders and a total weight in working order of 210,000 lb., 23 heavy Pacific type locomotives with 27 by 28 in. cylinders and a total weight in working order of 304,000 lb., and 10 consolidation type locomotives with 22 by 30 in. cylinders and a total weight in working order of 250,000 lb., a total of 84 engines, all ordered from the American Locomotive Company. Orders were also placed for 7 Mallet type locomotives with the Baldwin Locomotive Works and for 22 eight-wheel switching locomotives with the Lima Locomotive Works.

New cars and locomotives

The number of freight cars installed in service in the month of January was 4,907, as shown by reports of the Class I railroads filed with the car service division of the American Railway Association. The total in January, 1925, was 12,735 and in January, 1924, it was 16,192. The present total of 4,907 includes 1,345 box cars, 2,747 coal cars and 325 refrigerators. Freight cars on order on February 1 totaled 50,636, including 24,858 box, 21,298 coal and 1,808 refrigerator cars. On February 1 last year freight cars on order totaled 59,295 and the year before that 25,390.

Locomotives placed in service during the month of January this year totaled 191 compared with 167 in January, 1925, and 271 in January, 1924. Locomotives on order this year, 493, compared with 280 last year and 439 on the same date two years ago.

These figures include new, rebuilt and leased equipment.

B. & M. to reclaim coke from locomotive ashes

A plant for reclaiming coke from locomotive ashes is to be constructed by the Boston & Maine at East Somerville, Mass., adjacent to its enginehouse and shops. It is expected that the railroad will be able to obtain in this manner practically all the fuel required for station heating. Present station requirements aggregate approximately 30,000 tons a year.

This project, so far as known the first of its kind by any railroad in this country, will recover from the locomotive waste now dumped into ash heaps unburned coke which tests have shown to average from 33 to 40 per cent of the ash. The Boston & Maine expects to recover approximately 30 per cent by the new process.

This process is an adaptation of one used in the hard coal fields for separating impurities. It is based on the comparative specific gravity, and by means of water flotation the coke is segregated and the cinder residue precipitated.

The new plant will cover an area approximately 30 ft. by 100 ft. It will cost about $50,000, and will handle 2,000 tons of ashes weekly, from which approximately 600 tons of coke is expected to be reclaimed. The cinders to be handled by the new plant will be largely those dumped from locomotives in Greater Boston enginehouses and shops, but if the results warrant, the reclamation process may be extended to apply to the ashes from locomotives elsewhere on the system.

Northern Pacific locomotive makes 1800 mile run

The Northern Pacific has just completed a record-breaking continuous freight run, handled by a single locomotive, from its Seattle freight terminal to its Twin Cities freight terminals. The distance of 1,897.6 miles, over three mountain ranges with a maximum grade of 2.2 per cent, was covered in 109 hr. 30 min. total time, with a coal-burning locomotive which was not detached from the train nor given any mechanical attention whatever at terminals during the entire trip. An average speed of 17.4 miles an hour was made, including stops which aggregated 4 hr. 43 min. at terminals for tonnage changes.

The locomotive is of the Mikado type, having a tractive force of 57,100 lb., and is equipped with a stoker, trailer booster, superheater, feedwater heater and round hole type of grates with a restricted air space opening of 12½ per cent. The grates are designed for burning the semi-lignite and screenings coal ordinarily burned over a portion of the line and which permitted on this particular trip the burning of four different kinds of coal, including the semi-lignite, without the necessity for cleaning fires at

terminals. It was estimated that a total of 353 tons of coal and 442,000 gal. of water were consumed on the trip.

A full-tonnage train was handled over all divisions, the train load varying from 1,600 to 5,000 tons according to the grade, and consisted of 84 cars over the eastern end of the line.

The locomotive was taken from regular pooled freight service and started on the run with only the customary inspection and needed running repairs. Sixteen engine crews were taken in their turn from chain-gang freight service to handle the locomotive over the territory which, in ordinary operation, requires 12 locomotives.

Boston & Maine discusses field of the rail motor car

The Boston & Maine, which has just placed an order for 10 gas-electric motor rail cars, bringing to approximately $1,000,000 its investment in this character of equipment, has made some pertinent comment on the use of this equipment in the forthcoming annual report for 1925.

The report contains the announcement that three of these new cars, seating 90 persons each and equipped with double-end control, will be used in suburban service at other than rush hours. The report continues:

"While there is a field for the self-propelled passenger car on steam railroads, the scope is by no means universal. The power and capacity of such cars are inadequate to meet the peak requirements of commutation traffic, and in the case of short branch lines with very light traffic, the investment and operating cost are out of all proportion to the revenue. In the former class of traffic, motor rail cars cannot satisfactorily replace steam with the greater capacity of the latter for handling peak loads; in the latter class, the highway bus appears to furnish the economical solution.

"There is an intermediate field, however, where the passenger traffic does not warrant steam service, and in some instances the introduction of a less expensive substitute may permit of greater frequency of service and result in the retention of traffic which otherwise would be diverted to public or private transportation on the highway."

Most of the new cars, like most of the 13 which are now in operation, are intended to supply such an improved and economical service for branch lines. Discussing further the use of this equipment, the Boston & Maine's report says:

"While the development of gasoline motor cars for passenger transportation on the rails cannot be said to have passed beyond the experimental stage, the economies as compared with steam service have appeared to be sufficient to justify a substantial investment in this type of equipment.

"The Boston & Maine now has in service 13 gasoline rail passenger cars of which eight are mechanically driven and five are of the gas-electric type. Eleven additional cars are now under order —all of the gas-electric type.

"These cars are being operated on both main lines and branches, the following runs being indicative of the service to which they are believed to be adapted: Boston-Northampton, North Adams-Troy, Nashua-Worcester, Portland-Rochester, Salem-Lowell, Springfield-Greenfield.

"Practically all of these cars are intended to haul an additional car of light construction. Among the cars under order, however, are three with double-end control having a seating capacity of over 90 passengers. These are intended for interurban service at other than rush hours."

Meetings and Conventions

National Committee on Wood Utilization to meet April 28

Herbert Hoover, Secretary of Commerce and chairman of the National Committee on Wood Utilization, has called a meeting of the National Committee members for April 28, 1926, at its headquarters in the Department of Commerce, Washington, D. C. This committee, established by direction of President Coolidge, is composed of important consumers, distributors and manufacturers of wood and wood products who aim to promote a more efficient utilization of wood that more and better lumber and wood products may be produced from each tree, thereby effecting a saving in the number of trees necessary to be cut to supply the nation's timber needs. Heretofore, but from 25 to 35 per cent of the standing tree has been marketed, and, in order to increase this percentage, the committee will consider at its meeting on April 28 a wide range of suggestions for undertakings to eliminate wood waste. Its work, through sub-committees composed of leading technical and practical men in each special field, will extend into the manufacture of lumber, pulp, paper, wood chemicals, naval stores, charcoal, composition board and other by-product possibilities. Means and methods whereby the transportation and distribution of lumber and wood products will be effected in a more efficient and economical way, and efficient logging, saw milling and wood working practices also will receive careful study.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4 to 7 inclusive, Hotel Roosevelt, New Orleans, La.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer,* 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting April 13. Paper on freight claims will be presented by C. F. Macdonald, freight claims agent, Boston & Maine, Boston, Mass.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting April 5. A paper on the preparation of freight car brakes for the descent of mountain grades will be presented by W. F. Peck, supervisor of air brakes, B. & O., Baltimore, Md.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

International Railway Fuel Association.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting April 13. A paper on designing locomotives to reduce rail stresses will be presented by H. H. Lanning, mechanical engineer, Atchison, Topeka & Santa Fe.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting April 16. Paper on Gas electric drive for motor buses will be presented by H. L. Andrews of the General Electric Company.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month Terminal Hotel Bldg., Fort Worth, Texas. Next meeting April 6. Program in charge of Texas & Pacific Railway.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The general offices of the Commonwealth Steel Company are now in the new office building at its plant in Granite City, Ill.

The Morton Manufacturing Company, Chicago, will construct a two-story factory 85 ft. by 220 ft., to cost approximately $95,000.

The Central Steel Company, Massillon, Ohio, has opened a district sales office at 404 West First street, Tulsa, Okla., in charge of L. S. Allen.

C. S. Carter has been appointed sales representative of the Locomotive Firebox Company, Chicago, with headquarters at Minneapolis, Minn.

H. J. Tierney, F-19 Railway Exchange, St. Louis, Mo., has been appointed St. Louis representative of the Davis Brake Beam Company, Johnstown, Pa.

A. S. Anderson, formerly secretary of the Terre Haute Malleable Manufacturing Company, Terre Haute, Ind., has been elected president of the Standard Malleable Castings Company to succeed Emil J. Fischer, resigned.

E. M. Ivens, formerly representative of the Ingersoll-Rand Company, with headquarters at New Orleans, La., has been appointed special agent of the Chicago Pneumatic Tool Company, with headquarters at Chicago.

James C. Dannaher will in future look after the Pacific coast railway business of the Murphy Varnish Company, Newark, N. J. Mr. Dannaher will have his headquarters at the company's San Francisco, Cal., branch, 555 Mission street.

H. B. Pflasterer, formerly sales representative of the Hazard Manufacturing Company, with headquarters in Chicago, has been appointed railroad sales engineer of S. F. Bowser & Co., Inc., Ft. Wayne, Ind., with headquarters in Chicago.

The Harnischfeger Corporation, Milwaukee, Wis., has appointed the William H. Hale Company, Minneapolis, Minn., its agent in Minnesota. The Clark-Wilcox Company, New Haven, Conn., also has been appointed agent to succeed the K. B. Noble Company.

The Boye & Emmes Company, Cincinnati, Ohio, has placed a contract with the Austin Company for an entire new plant to replace its old one-story and basement structure which was recently destroyed by fire. The new plant will be 90 ft. by 340 ft., of monitor type construction.

The Foster Bolt & Nut Manufacturing Company, Cleveland, Ohio, will construct an addition to its plant at Cleveland, following the completion of the addition which it is now constructing. This company is also erecting a plant at Chicago, which will be placed in operation by May 1.

C. E. Graham, formerly senior vice-president of the Chesapeake & Ohio, has now severed his last connection with the property by resigning as vice-president of the Hocking Valley. Mr. Graham has entered the general railway supply business in New York City, with office at 51 East Forty-second street.

A. H. Purdom, formerly connected with the railroad department of Johns-Manville, Incorporated, Chicago, Ill., has resigned to take a position in the railway department of the Wood Conversion Company, 310 South Michigan avenue, Chicago, manufacturers of refrigerator and passenger car insulations.

Ausborn F. Old, eastern sales manager, at New York, of the Hale-Kilburn Company, Philadelphia, Pa., died after a brief illness of pneumonia at the Fifth Avenue hospital in New York City, on March 16, at the age of 80. Mr. Old had been with this company for the past 35 years serving in its sales organization.

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has opened a new sales office in the Healey building, Atlanta, Ga. A. C. Gibson, formerly of the Philadelphia office, is in charge of this office. The General Machinery Co., Birmingham, Ala., will continue to serve its trade in the northern half of Alabama.

R. J. Sharpe, district representative at Tulsa, Okla., of the General American Tank Car Corporation, Chicago, has been appointed general sales manager, with headquarters at the general offices in Chicago. J. V. O'Neil has been appointed district representative at Tulsa, succeeding Mr. Sharpe.

The Twentieth Century Gravity Lubricator Company has been incorporated, with headquarters at 21 Kolb avenue (Belmar), Baltimore, Md. W. E. Crist is president and treasurer; C. W. MacQueston, vice-president, and S. S. Crist, vice-president and secretary. The company was organized to manufacture oil cup lubricators for journal boxes.

The DeVilbiss Manufacturing Company, Toledo, Ohio, will spend more than $1,000,000 this year on the enlargement of its plant and the beautification of its grounds. The principal new buildings will be an office building, 180 ft. by 80 ft., and a factory building, 582 ft. by 80 ft., both of which will be connected by bridges and covered passageways.

T. W. Bennett, service engineer for the Locomotive Stoker Company, Pittsburgh, Pa., is now in Australia to supervise the initial operation of Duplex stokers on ten new Mountain type locomotives built according to American practice, by the Sir W. G. Armstrong Whitworth Company in England, which will soon go into service in South Australia.

The Interstate Car & Foundry Company, Indianapolis, Ind., formerly the Interstate Car Company, has been organized by G. J. Diver, manager of the Interstate Car Company, who will be president, and L. R. Meyer, also connected with the Interstate Car Company, who will be vice-president and secretary. The new company will manufacture grey iron and semi-steel castings.

Following the death of R. E. Bebb, chairman of the board, which was noted in the March *Railway Mechanical Engineer*, various officers of the Central Steel Company, Massilon, Ohio, were promoted as follows: F. J. Griffiths, chairman of the board; C. E. Stuart, president and treasurer; B. F. Fairless, vice-president and general manager; J. M. Schlendorf, vice-president in charge of sales, and Charles C. Chase, Jr., secretary. George H. Freeborn, who has been auditor of the company for a number of years, was elected a member of the board and assistant treasurer.

The Standard Forging Corporation, of Delaware, has elected the following directors and general officers: G. E. Van Hagen, president and general manager; C. R. Lewis, vice-president and general manager of sales; L. C. Ryan, vice-president and treasurer and A. C. Stockton, vice-president and secretary. The recently acquired Pollak Steel Company plant at South Chicago, Ill., will be operated under the name of Standard Forgings Company, South Chicago plant. The plant at Indiana Harbor, Ind., will continue under the name of Standard Forgings Company and the plant at East St. Louis, Ill., will continue under the name of St. Louis Forgings Company.

Lee & Clark has recently been incorporated to take over the business conducted as a partnership under the name of the James T. Lee Company. James T. Lee is president and John O. Clark is vice-president, with offices at 549 W. Washington Boulevard, Chicago. The company specializes in hydraulic equipment, plate working tools, metal working machinery, pumps, car wheel borers, pipe benders, flexible steam joints, etc. Mr. Lee was formerly vice-president of the Hanna Engineering Works, Chicago, and for the past five years was western manager of the Southwark Foundry & Machine Company. Mr. Clark, for a number of years, was sales manager of the Hanna Engineering Works, Chicago.

The Peerless Malleable Castings Company, Toledo, Ohio, has been incorporated as the successor to the United States Malleable Iron Company, the latter company having been sold in the federal court. Officers of the new company are Elmer H. Gerson, president; Ira L. Houghton, vice-president and general manager; and J. M. Weil, secretary and treasurer. Mr. Houghton entered the employ of the National Malleable Castings Company in 1891 as a core room clerk and since that time has been associated with the plants of the Michigan Malleable Iron Company, the Grand Rapids Malleable Works and the United States Malleable Iron Company. In 1916 he resigned from the latter company to organize and operate the Maumee Malleable Castings Company, Toledo, Ohio. In 1919 he sold his interest in that concern and in October, 1922, entered the employ of the United States Malleable Iron Company as vice-president and general manager, which position he has held until his recent appointment.

A correction

In the item regarding the change in name of the Chicago Steel Car Company, Harvey, Ill., to the Gibson Car & Manufacturing Company, it was stated that there had been a change in the personnel of the company. This was incorrect as no change whatever was made in the official roster of the Chicago Steel Car Company when its name was changed, and no one in any other corporation has any interest in the Gibson Car & Manufacturing Company.

Mr. Woodin optimistic

William H. Woodin, president of the American Car & Foundry Company and the American Locomotive Company has sailed recently on a business trip abroad. Before leaving he was quoted as saying that both of the companies of which he is the head are now operating in excess of 50 per cent of capacity. Continuing he added:

"The acquisition of the Hall-Scott, Fageol, and J. G. Brill Company by the American Car & Foundry Securities Corporation should add materially to the earnings of American Car & Foundry Company. Hall-Scott makes one of the best motors on the market and if the need arises, American Car & Foundry has four large car-building plants which may be turned over to bus-body making on short notice.

"I also want to deny the rumor that American Car & Foundry is thinking of acquiring the Pullman Car & Manufacturing Company if it is ever segregated from the Pullman Company proper, because the Federal Trade Commission would not allow such a merger, as it would be in restraint of trade. You will notice that all the mergers which we have participated in have been for the benefit rather than the restraint of trade; they have not been with competing companies."

American Locomotive Company to acquire Railway Steel Spring Company

One of the most important developments in the railway supply field in a long period of years is contained in the recent announcement that the American Locomotive Company will take over the Railway Steel Spring Company. Stock of the locomotive company will be issued in exchange for stock of the spring company. Frederick P. Fitzpatrick, president of the Railway Steel Spring Company, is to become president of the locomotive company, and William H. Woodin, president of the American Car & Foundry Company and of the locomotive company, is to become chairman of the board of the enlarged locomotive company.

The official announcement gave details as follows:

"The boards of directors of the American Locomotive Company and the Railway Steel Spring Company, realizing that there are substantial economic advantages to be gained by a merger of the two companies, after a careful analysis of the two properties, have agreed upon what they believe to be the proper ratio of exchange, and are calling stockholders' meetings of their respective companies, recommending their approval of the merger.

"The Locomotive stockholders will be asked to increase both the preferred and common capital of their company so that they may, if the Railway Steel Spring shareholders accept the recommendation of their board, acquire the assets of the Railway Steel Spring Company by the delivery of securities that will permit each preferred stockholder of the Railway Steel Spring to receive one share of American Locomotive preferred for a share of Railway Steel Spring preferred, and each holder of a share of Railway Steel Spring common to receive two-thirds of a share of Locomotive common.

This merger and the basis agreed upon is approved by the largest shareholders of both companies.

Obituary

Robert Hobson, chairman of the board of the Canadian Locomotive Company, Ltd., Hamilton, Ontario, and president of the Steel Company of Canada, Ltd., died on February 25 at his home in Hamilton, at the age of 65. He first began work on the railroads but later became secretary-treasurer of the Hamilton Blast Furnace Company. In 1899 he went to the Hamilton Iron & Steel Company as general manager, and in 1910 was appointed general manager of the Steel Company of Canada, Ltd., becoming president of that company in 1916. He had served also as an officer or a director of a number of financial and industrial organizations.

Trade Publications

Wrenches.—A miniature 56-page, illustrated catalogue of Williams Superior drop-forged wrenches is being issued by the J. H. Williams & Co., Buffalo, N. Y.

Power drive.—A four-page folder descriptive of the No. 44 Beaver power drive for cutting, reaming and threading pipe has been issued by the Borden Company, Warren, Ohio.

Separator magnets.—The construction details and operating characteristics of E. C. & M. separator magnets are given in a four-page illustrated folder issued by the Electric Controller & Manufacturing Company, Cleveland, Ohio.

Gaskets.—Catalogue 26, descriptive of a complete line of gaskets for air compressors, boilers, drums, joints, etc., has been issued by the Metallo Gasket Company, 12 Bethany street, New Brunswick, N. J. Price lists also are included in this catalogue.

Locomotive force feed oiler.—A thermostatically controlled heater is embodied in the new Model A locomotive force feed oiler which is described in Bulletin No. 18 issued by the Detroit Lubricator Company, Detroit, Mich. The details of construction of this lubricator are shown in various cross-sectional drawings.

Bonney wrenches.—Catalogue No. 26 issued by the Bonney Forge & Tool Works, 405 Stephen Girard building, Allentown, Pa., has been reproduced in miniature in order to provide a handy reference for the mechanic. The three types of "CV" chrome vanadium socket wrenches; namely, the offset, "T" handle and the speed type, are shown in this catalogue.

Small tools.—A new edition of a small tool catalogue, to which has been added for the first time pages descriptive of special work, special gages, the correct use of tools under actual shop conditions and new tables, has been issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. Among the tools listed in this catalogue, No. 30, are micrometers, rules, gages, punches, scribers, screw machine tools, cutters, etc.

Nickel steel data and applications.—The International Nickel Company, New York, is issuing a series of twelve technical bulletins on nickel steel. Bulletin No. 1 describes the Society of Automotive Engineers standard specifications for steel and Bulletin No. 2, the physical and mechanical properties of nickel steels. Subsequent bulletins will be issued at bi-monthly intervals. Binders for these loose leaf bulletins will be furnished on request.

Thread standardization.—In accordance with the recommendations adopted by the die head and chaser industry in collaboration with the Department of Commerce, Division of Simplified Practice, the Geometric Tool Company, New Haven, Conn., is issuing in folder form tabulations of those sizes of chasers which it considers stockable and which will be furnished without extra charge. All other chasers not listed in these tables will be regarded as non-stockable.

Leather belting.—A report of experiments conducted by R. F. Jones, research engineer, at Cornell University, to determine the relative power transmitting capacity of belts on vertical, angular and horizontal drives has been issued by the Leather Belting Exchange, 119 South Fourth street, Philadelphia, Pa. In this report the author also has correlated the results with the method of belt design published in pamphlet R-13, so that this same system with modifications can now be used for vertical and angular drives.

Bar work.—Book 1 of a series on modern tooling methods giving practical information and suggestions for the correct handling of turret lathe tool equipment for both large and small lot production, has been issued by The Warner & Swasey Company, Cleveland, Ohio. The problems of bar work are discussed in this book; a number of typical bar tool layouts given; the design of individual tools treated, and the possibilities of developing a Universal tooling equipment shown. The next two books of the series will deal with chuck work and will discuss the principles of increasing production, giving particular attention to holding devices.

Personal Mention

General

B. L. BUTLER has been appointed water service and fuel supervisor of the Southern Pacific, with headquarters at Dunsmuir, Cal., to succeed J. B. Duncan, Jr., resigned.

J. H. REISSE, mechanical inspector of the Chicago, Burlington & Quincy, at Chicago, has been appointed mechanical assistant to the vice-president, with the same headquarters.

D. R. MACBAIN has been promoted to general manager of the New York Central, lines west of Buffalo, with headquarters at Cleveland, Ohio. Mr. MacBain was born on October 23, 1861, at Queenston Heights, Ont., and entered railway service in October, 1876, as a machinist apprentice on the Canadian Southern, now a part of the Canadian National. He was promoted to locomotive fireman in May, 1878, and in 1882 was promoted to locomotive engineer. Mr. MacBain was appointed traveling engineer on the Canada division of the Michigan Central in 1890, and three years later was transferred to the district west of the Detroit river. He was promoted to master mechanic of the Western division in July, 1900, and in April of the following year was transferred to St. Thomas, Ont. He was transferred to Jackson, Mich., in January, 1902, and remained there until July, 1906, when he was promoted to assistant superintendent of motive power, with headquarters at Detroit. Mr. MacBain was transferred to the New York Central, with headquarters at Albany, N. Y., in April, 1908, and in May, 1910, was promoted to superintendent of motive power of the Lake Shore & Michigan Southern, the Lake Erie & Western, the Lake Erie, Alliance & Wheeling, the Dunkirk, Allegheny Valley & Pittsburgh, the Cleveland Short Line, the Chicago, Indiana & Southern and the Indiana Harbor Belt. He was promoted to assistant general manager of the lines west of Buffalo, with headquarters at Cleveland, in June, 1919, and held that position until his recent promotion to general manager.

D. R. MacBain

Master Mechanics and Road Foremen

F. E. Sellman has been appointed assistant master mechanic of the Pennsylvania with headquarters at Akron, Ohio.

E. J. CYR has been appointed assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, succeeding J. S. Ford.

H. C. TURNER has been appointed assistant master mechanic of the Ottumwa division of the Chicago, Burlington & Quincy, with headquarters at Burlington, Ia.

J. T. Leach, master mechanic of the Pennsylvania, with headquarters at Mahoningtown, Pa., has been transferred to Wellsville, Ohio, succeeding F. E. Sellman.

J. S. FORD, assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, at Galesburg, Ill., has been promoted to master mechanic of the Galesburg division in place of W. A. Kelly.

W. A. KELLY, master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, at Galesburg, Ill., has been transferred to the Ottumwa division, with headquarters at Ottumwa, Ia., succeeding H. C. Turner.

Shop and Enginehouse

H. L. SHAW has been appointed erecting shop foreman of the Chicago & Alton, with headquarters at Slater, Mo., succeeding W. H. Dillon, resigned.

W. B. MURNEY, traveling locomotive inspector of the St. Louis-San Francisco, has been appointed general enginehouse foreman, South Enginehouse, with headquarters at Springfield, Mo., succeeding F. W. Lampton, resigned.

Car Department

L. R. CHRISTY, general car inspector of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to master car builder of the Gulf Coast Lines and the International Great Northern, with headquarters at Houston, Tex., a newly created position.

Obituary

JOHN T. EWING, engineer of tests of the Chesapeake & Ohio, died on March 4, of heart disease in the Stuart Circle Hospital, Richmond, Va.

BENOIT BRIARD, purchasing agent of the Chicago Great Western, with headquarters at Chicago, died in that city on February 11 after an operation for appendicitis. Mr. Briard was born on February 9, 1865, in St. Louis, Mo., and entered railway service in June, 1879, as a messenger in the office of the local freight agent of the Chicago & Alton at Chicago. In December, 1879, he took up the study of telegraphy, returning later to the Chicago & Alton as telegraph operator and clerk in the local freight office at Chicago. He was transferred to the general freight department in 1880 and in April, 1882, was transferred to the purchasing department. Mr. Briard was promoted to stationer in January, 1894, later being promoted to chief clerk and assistant to the purchasing agent. He was later promoted to chief stationer of the Alton, the Toledo, St. Louis & Western, the Minneapolis & St. Louis and the Iowa Central. In November, 1909, Mr. Briard was appointed purchasing agent of the Chicago Great Western and he held that position until his death.

W. J. TOLLERTON, general superintendent of motive power of the Chicago, Rock Island & Pacific, with headquarters at Chicago, died in that city on March 3, of intestinal influenza. Mr. Tollerton was born in 1870 at St. Paul, Minn., and was educated in the public and high schools. He entered railway service as a machinist apprentice on the St. Paul & Duluth, now a part of the Northern Pacific, and subsequently became a fireman on the Chicago, St. Paul, Minneapolis & Omaha. From 1890 to 1896 he was a foreman and afterwards general foreman of the Union Pacific, and from the latter date until 1903 was master mechanic of the Utah division of the Oregon Short Line. From 1903 to July, 1906, he was master mechanic of the Idaho, Utah and Montana divisions of the same road at Pocatello, Idaho. He then became superintendent of motive power of the Chicago, Rock Island & Pacific, in charge of the lines west of the Mississippi river, with headquarters at Topeka, Kans., where he remained until April, 1907, at which time he became assistant general superintendent of motive power of the Rock Island Lines, with headquarters at Chicago, Ill. He became mechanical superintendent in May, 1912, and general mechanical superintendent on January 1, 1913. In May, 1923, Mr. Tollerton's title was changed from general mechanical superintendent to general superintendent of motive power.

W. J. Tollerton

Railway Mechanical Engineer

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It was testified at a recent car foremen's meeting that some railroads do not even take the trouble to keep a record of hot boxes in freight service.

A thought on hot boxes

While this statement may be somewhat exaggerated, as Mark Twain said about the report of his death, the question may well be raised if many railroads are not paying too little attention to the lubrication of freight equipment as compared to passenger equipment when the former is in reality the principal revenue earner. How otherwise is it possible to account for the fact that as many as two or perhaps three million miles per hot box is obtained in passenger train service, whereas 50,000 miles per hot box is an unusually good performance in freight service. Even making due allowance for the much greater speed and mileage of passenger cars, this would seem far too great a discrepancy in performance. Further evidence in the matter is afforded by a comparison of the respective lubrication costs. A large railroad system which is watching its mechanical department costs carefully reports a cost of 13.37 cents per 1,000 freight train car miles in 1925 as compared to 29.59 cents per 1,000 passenger train car miles in the same year. With the far greater number of cars and journals in the average freight train as compared with a passenger train, it is difficult to understand why the lubrication cost should be less than half on a 1,000 train-car-mile basis. It is well known that "familiarity breeds contempt." Have railroad men, through long custom, become used to hot boxes in freight service and, consequently, satisfied with a standard of performance considerably lower than that possible of attainment? Considering the dependance of railroads upon their earnings in freight service and the considerable cost of each individual hot box when all contributing factors are considered, it seems apparent that more time, thought and probably money, may profitably be expended in an attempt to minimize hot box troubles in this service.

The railroads employ many men and spend large sums of money annually in making records required for government reports and the information of the individual roads.

Make records useful

While there is a feeling in some quarters that these records are unnecessarily voluminous and expensive to make, the fact remains that without accurate records efficient operation in any branch of railroad work is impossible. Records must be not only as accurate as possible, but a general, clear-cut understanding of what each individual record means is essential. Many railroad records are seriously deficient in the latter respect. Take, for example, the records of flue service. A number of expressions are used in connection with flue reports such as "flues renewed," "repaired," "re-set," "second-hand" and "worked over." What is the significance of these various terms? The fact is that they often mean different things at the various shops on the same railroad as well as on different roads, and the ambiguity and confusion is such that when a mechanical officer wants to trace the life of flues which may be safe-ended and re-set in a number of boilers in determining the seriousness of the pitting problem, he finds himself without definite, reliable information. It would seem that definite instructions should be issued from the general mechanical headquarters limiting these terms to the ones absolutely essential for record purposes and defining each one so that there will be a general understanding of what each means and thus prevent the possibility of including new flues, safe-ended flues and re-set flues all in the same tabulation with a result which is practically meaningless.

Another more or less ambiguous term which might be cited is the hot box. Almost anyone will say on first thought that they know what a hot box is, but, as a matter of fact, one road may consider a hot box to be any journal heating which causes a train delay, whereas another road may count only those hot boxes which occasion the setting out of cars. Accurate records in which the terms are clearly defined and generally understood are absolutely essential to efficient railroad operation. Without them supervising officers are unable to examine past performance intelligently and use it as a guide for present and future practice.

The heartiest co-operation should exist between the various department foremen in a railroad shop not only for the benefit of the railroad but for the mutual benefit of the foremen as well, and the success of a general shop supervising officer is measured in no small degree by his ability to promote this feeling of good will.

Mutual helpfulness pays

The value of team work between department foremen is well known, being reflected in the attitude of the various groups of shop men towards each other, but unfortunately a high degree of team work is not always practiced. Lack of harmony and studied effort to help the other fellow in his work was plainly evident in a shop where the following incident occurred: A machinist and helper in the shoe and wedge gang needed liners in connection with their work of lining the shoes and wedges on a certain locomotive and after drawing a sketch to indicate the size and gage of the liners, a written order was obtained from the gang foreman and the helper took it to the boiler shop where the only power shear available was employed on important boiler work. As usual, the locomotive going out got the preference and the boiler foreman had to interrupt his work while the shear operator hunted up material of the right gage and sheared it to the size called for on the sketch. A short time later the machinist helper was back again with an-

other order for liners of different gage or for another class of engine. The boiler foreman rebelled, refusing to remove his work from the shears and as a consequence the helper stood around 15 or 20 min. waiting for the liners while his machinist back in the erecting shop was delayed accordingly. Complaint was made to the general foreman and hard feelings ensued between the two department foremen involved. A little advance study of the needs would have shown the erecting shop gang foreman in this case about how many shoe and wedge liners of a few standard sizes he would use in the course of a month, and, by placing the order well in advance, would have enabled the boiler foreman to turn them out quickly and at a time when the use of the power shears for this purpose would not interfere with the regular routine of boiler shop work. Many other examples of a similar nature might be cited. In general, railroad shop foremen see the advantage of pulling together in their work of maintaining cars and locomotives and where one foreman may be somewhat short-sighted in this respect it is the duty of the others to get together and bring pressure to bear, as diplomatically as possible but firmly, to show him the error of his ways.

Engine inspection methods

The prevalence of long engine runs has brought out in no uncertain terms the need of particularly careful inspection methods at initial terminals, a necessity also found vital to successful results in the campaigns for reduced engine failures being conducted by many roads. Considerable difference of opinion exists regarding the inspection methods which prove most effective and also regarding the kind of form best adapted to reporting defects. One railroad system has instituted a method whereby the inspector starts at the rear of the tender on the left side, going to the front and working back on the right side. He then goes under the tender, works underneath to the front of the engine, and finally inspects the cab and other overhead work. With this method, a laborer is provided to accompany the inspector, supply the necessary tools and material and enter the defects and repairs on the record card. Some master mechanics and experienced enginehouse foremen doubt the necessity of extended inspection after the locomotive is offered for service on the ground that it indicates improper initial inspection and repair work. On the other hand at least one or two roads maintain inspectors clothed with all the authority on those particular roads of federal inspectors and with full power to issue what practically amounts to a Form 5 for any locomotive which has been offered for service, with reportable defects not corrected.

The form of work report is highly important. A report containing detailed references to all the important locomotive and tender parts which must be inspected and checked has the double advantage of calling these parts to the attention of enginemen and engine inspectors and minimizing the amount of writing which must be done in making out reports. On the other hand, some master mechanics feel that the space allotted for each item on an extensive report of this kind is usually inadequate and the constant presence of specified items on a printed form leads the engine inspectors to take them as a matter of course and consequently the form loses some of its intended value as a reminder. Another possible disadvantage of the extensive report is that the engine inspectors by being required to check over a lengthy list of individual items have less time to give to actual inspection and locating defects.

Enginemen are usually released from responsibility from all but exterior inspection of engines together with certain other features on which they are required to report, but constant checks must be made to determine how carefully the enginemen make out the items on the report for which they are responsible. It is often found that a number of parts marked on the top of a work report as being in good condition will be reported in need of repair under special notations at the bottom of the form. Experience in certain cases has shown the possibility of marked improvement in engine inspection methods by giving the inspectors special instruction and examination at stated intervals.

Following are some of the factors which must be kept in mind in developing the most desirable kind of work report: (1) Work must be definitely specified to avoid loss of time of mechanics in locating and correcting it; (2) space must be available for a detailed report of all work necessary, together with repairman's signature in order that responsibility for the repairs may be definitely located; (3) since routine work incidental to checking a large form has a tendency to promote slipshod inspection, too much detail must not be shown on the printed form; (4) this will also save the inspector's time which may be more profitably concentrated on specific parts which are giving trouble.

Take care of machine tools

Fundamentally, railroad repairs are on a job shop basis requiring a variety of machine tools, all of which handle many different jobs, each requiring a different set up. This factor, together with the time element which enters into the majority of the railway repair jobs, results in the machine tool equipment having to withstand much harder usage than is common to machines on production work. As a result, it is not uncommon to find a foreman embarrassed owing to a machine torn down for heavy repairs. Of course, machinery will wear and must be repaired. But, in many cases, the extent of the repairs required could be reduced considerably by the application of a few simple precautionary methods.

First of all, a machine repairman or repair gang should be selected for their all round mechanical ability and resourcefulness. These men should be trained to watch all machines closely and, at the first sign of impending trouble, should take the machine out of service and make any necessary repairs before a serious breakdown occurs. When a new part has to be machined in a hurry, accuracy and the ability to follow instructions should be the paramount qualifications required of the man selected to do the work. A poorly or inaccurately machined part will, in many cases, necessitate tearing down the machine again after it has been repaired. In order to secure good workmanship this man should receive satisfactory compensation for his ability, especially if he is taken off a piecework job to do such work.

Another factor affecting the extent of serious machine breakdowns is the operator, particularly if he is working piecework. A skilled operator, accustomed to his machine, should know at once when it is not performing properly. When he is suspicions of impending trouble, it should be promptly reported to the foreman. If he does not do this, he is not only hurting himself financially, but is not playing fair with his foreman, who is responsible for production. If, however, the foreman disregards a timely warning on the plea that the machine cannot be taken out of service at that time and then the machine completely breaks down, the foreman is not only a deterrent to employee co-operation, but is also a shortsighted supervisor.

There are a few mechanical features on machines which can be readily improved at a minimum expense and time which will aid materially in prolonging the service life of a machine. Many machines, purchased ten years or more ago, lack provision for proper lubrication, having a number of small uncovered oil holes. Many of these machines are not provided with wicks in the oil holes or provision to filter out any grit fed in with the oil. Still fewer are fitted with felt for distributing the oil and wiping cuttings off the journals to prevent galling. These defects are usually simple and can be easily remedied by a small amount of time and effort.

Ten years or more ago heat treatment was not as highly developed as now. As a result, in machines ten years old, many of the parts subjected to wear cannot withstand the wear imposed on them in the railroad shop. It has been found worth the time to take out such parts and caseharden or heat treat them properly, thus greatly prolonging their wearing life and accuracy. It is also another good policy whenever machines are overhauled to chamfer off the corners of gear teeth to a radius equal to one half the tooth depth and to file all burrs or sharp edges on the teeth or other wearing parts.

The policy of keeping all machine tools at a high state of efficiency reverts back to the old adage that "an ounce of prevention is worth a pound of cure."

Factors contributing to good shop operation

Elsewhere in this issue appears the second and concluding article describing the Pennsylvania Railroad's new locomotive repair shop, a unit of the Altoona Works, in which, during the 22 working days in the month of December, 1925, 103 locomotives received classified repairs. This output is a real achievement when it is taken into consideration that the work was done on 45 repair tracks which means that over two locomotives were repaired on each track during the month. These results were made possible by those responsible for the shop layout, equipment and organization. The shop is not entirely self-sustaining owing to the fact that it is furnished with new repair parts in a semi-finished state by other departments of the Altoona Works. As a result, the machine tool bays in the erecting shop were planned only to restore worn parts to standard dimensions and to complete the work necessary on new semi-finished parts. As a result, the number of machine tools for each locomotive repair track is considerably below the average figure.

Another factor that helps make possible maximum production is that, as a general rule, only four types of locomotives are repaired in this shop; namely, the Mikado, Decapod, Santa Fe and heavy Pacific types. As a result, the shop is equipped to handle these locomotives to the best advantage. Furthermore, the personnel of the shop becomes so familiar with these locomotives that in time they become specialists on these limited number of types, which is a big factor in maximum production. Of course, this method is only possible where a railroad has a large number of locomotives of the same type Standard locomotive equipment on any railroad is conducive to economical repairs.

Another contributing factor to the shop output is that all new and repaired parts are finished to standard dimensions. This is made possible by the extensive use of micrometers and gages. The railroads have been somewhat reluctant to work to close tolerances, the contention being that it is not necessary for locomotive repairs. At the Altoona Works, however, all fits wherever possible are either ground, milled or turned to tolerances measured in thousands of an inch so that all parts go together when assembled without the hand filing which is so prevalent in the average shop.

Since this is one of the largest shops, if not the largest shop in America devoted exclusively to locomotive repairs, it might be considered as offering a splended opportunity for the employment of an elaborate scheduling system. The volume of work passing through this shop might justify the overhead which, in the case of some smaller shops, has tended to defeat the purpose of elaborate scheduling systems. The system employed in the new plant, however, is one of the simplest in use in any railroad shop in America. That it is effective is suggested by the fact that, during December, every repaired part was finished and delivered according to the scheduled time.

Another factor contributing to the shop output is the selection and arrangement of the machine tools and shop equipment. The tools were selected with the following points in mind: to maintain heavy locomotives, to machine to the close limits made necessary by micrometer measurements, and to mill and grind wherever possible to do so.

No doubt a greater degree of specialization and refinement of certain practices is attainable in a shop of such large size than would be practicable in the average locomotive repair shop. But a close study of the methods and practices which characterize the new Pennsylvania shop indicates that by no means do all of them depend for their success on the magnitude of the operations with which they are associated. Standard tolerances, accompanied by precision methods of measurement, for instance, have a wide range of applicability and when such tolerances are once established it will be found that satisfactory fits are less difficult to attain than they are when the entire question of tolerance is left to the judgment and skill of the individual workman.

New Books

TRAVELING ENGINEERS' ASSOCIATION. *Edited by W. O. Thompson, Secretary, 1177 E. 98th St., Cleveland, O. 355 pages, 6 in. by 8½ in. Bound in Cloth.*

The proceedings of the thirty-third annual convention of the Traveling Engineers' Association held at Chicago, September 15, 16, 17 and 18, 1925, is of interest to road foremen of engines and others concerned with the problems of better locomotive maintenance and operation. In the front of the book is a list of the 1925-1926 officers and the constitution of the Traveling Engineers' Association and a brief report of the subjects considered at each convention since the first, which was held at Chicago in 1893. The report of the convention is divided into seven parts, one for each session. The six papers read and discussed during the convention dealt with the following subjects: Progress made on mechanical stokers and its effect on the cost of maintenance and operation; what progress has been made in the drafting of locomotives with a view of increased efficiency and economy in coal and oil fuels; mechanical appliances for lubrication of the modern locomotives; loss damage and discomfort due to rough handling by improper use of locomotive and air brake; the traveling engineer as a factor in dissemination of information to employees for economical movement of transportation; automatic train control. The majority of these papers were printed in abstract in the October, 1925, issue of the *Railway Mechanical Engineer*. A comprehensive index in the back of the book enables any of the papers as well as the discussions by the various members, to be located readily.

Gas-electric car for the Mexican National Railways

Diesel locomotive possibilities*

Main problem development of satisfactory machine at satisfactory price to user—Electric transmission favored

By Samuel M. Vauclain,
President, Baldwin Locomotive Works, Philadelphia, Pa.

THE steam locomotive has dominated transportation since its successful introduction approximately 100 years ago. It has steadily improved. Its performance, through greatly increased tractive force, has met the needs of modern transportation arising from the tremendous development of the world in the past 50 years. As a single self-contained power unit it is without equal so far as its general efficiency and low cost of production are concerned. Therefore, when discussing railway motive power, the standard of comparison must be the steam locomotive, which occupies a strongly entrenched position from both practical and sentimental viewpoints.

With the established efficiency of modern internal combustion engines before him, the designer of railway motive power is naturally attracted toward their possibilities of employment within his special field of endeavor. The Diesel motor shows an overall thermal efficiency as high as 33 per cent, while the best steam locomotive performance is about one-quarter of this figure. But even with this handicap, the steam locomotive of today is a remarkably flexible and reliable traveling power plant. In order to compete properly, no matter what the fuel economies may be, the internal combustion locomotive must approximate this same flexibility and reliability. It must have ease of control, ability to start a full tonnage train, and adaptability to the rapid change in physical conditions met in operation, such as variable speeds, gradients, curves and weather conditions. It must not be too complicated in detail nor too heavy per horsepower developed. Herein, then, are the basic features which the designer must constantly bear in mind. While a gain in thermal efficiency will warrant an increase in initial cost, the price must not be so prohibitive as to offset the anticipated gain in cost of operation.

European experience in Diesel locomotive construction has been more extensive than that of the United States and some late opinions on comparative costs are interesting. J. W. Hobson, of R. & W. Hawthorne, Leslie and Company, in an engineering discussion of 1925, states that in England the cost of Diesel locomotives with hydraulic transmission averages about 1.48 times the cost of a steam locomotive of equal capacity, complete with tender; and that the same measure of comparison for a Diesel-electric locomotive yields a ratio of 1.9. Dr. Herbert Brown, of the Swiss Locomotive and Machine Works, Winterthur, Switzerland, states that continental figures on the same basis yield an average cost for the Diesel-electric locomotive equal to 1.783 times the cost of the steam unit.

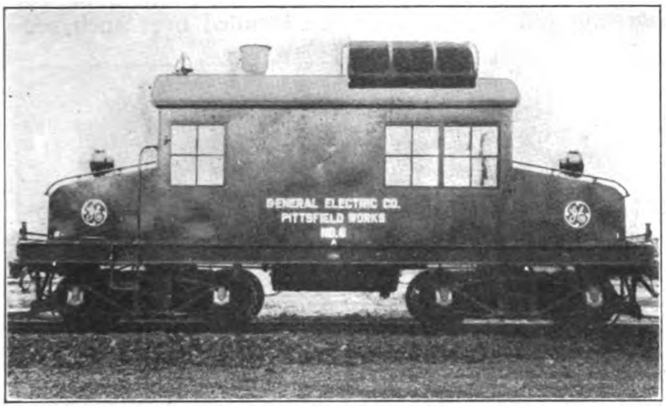
The problem naturally divides itself into the development of two general classes of power: self-propelled vehicles for light traffic, and locomotive units for hauling trains equal in tonnage to those hauled by steam locomotives. The first division offers easier accomplishment because the power required is low and the weight of engine and transmission details, compared with the entire weight of the vehicle, will make possible an economical unit; one which can be kept well within the restrictions of axle loadings, while allowing a high weight per horsepower developed. As the average full powered steam locomotive can be built within a weight of 140 lb. per horsepower, it should be quite easy to produce a low powered

*Abstract of a paper presented at Midwest Power Conference, Chicago, Jan. 29, 1926.

vehicle weighing, say 90,000 lb. (the weight of a modern steel day-coach) and operate it by power units producing 200 hp.; an arrangement giving 1 hp. to every 450 lb. Such a vehicle, even if the weight is increased by its machinery to 100,000 lb., can be operated economically up to its capacity, serve the needs of a light, or branch line traffic, and still not exceed an axle loading of 30,000 lb. on its principal driving axle.

Weight per horsepower a vital factor

In applying the Diesel heavy-oil engine to true locomotive units, the first consideration must be of the weight per horsepower developed. The heavier classes of Diesel engines in stationary service weigh within a range of 170 lb. to 350 lb. per horsepower. In locomotive service the weight of the Diesel engine must be added to the weight of transmission, running gear and vehicle body. If a 1,000-hp. Diesel engine of 170 lb. per horsepower is used in a locomotive, its weight of 170,000 lb. would exceed the total weight of a complete steam locomotive of like capacity. During the great war some Diesel engines



Gas-electric locomotive built for plant switching service by the General Electric Company

for submarine service were built showing a horsepower for every 65 lb. of engine weight. The locomotive designer needs this type of machine. The 1,000-hp. Diesel-electric locomotive built in Germany for the Russian Railways (1924) has a total weight of 275,000 lb.; 275 lb. per horsepower.

The 1,000-hp. rated Diesel-electric locomotive built in 1925 by the Baldwin Locomotive Works also weighs 275 lb. per hp. This indicates a close coincidence of the best European and American practice and sets for the present this weight per hp. for modern Diesel-electric locomotives. A slight decrease in weight can be looked for with an advance in locomotive horsepower, and the present expectation in this respect is about 220 lb., which represents a ratio of about 1 to 1.5 when compared with an average steam locomotive. With a thermal efficiency of 3 to 1 in favor of the Diesel engine, it appears that the added weight per hp. is not a severe handicap. Ratios of this character, provided they go hand in hand with simplicity, should show attractive operating economies. What, then, should be the features tending toward simplicity of maintenance?

Inasmuch as the Diesel or other internal combustion engine must be operated at speeds within its range of efficiency, and not a practically zero start, as in direct connection, the designer must find proper means for connecting the running prime mover to the locomotive driving mechanism. This transfer of power can be accomplished in three ways: By mechanical, stepped-gearing transmissions; by hydraulic, fluid-pressure transmissions; and transmission of power by electricity. Each of these systems will be separately described and examples given of locomotives so equipped.

Mechanical transmissions—These are of the ordinary change-speed stepped-gearing variety as applied in automobile practice, although in locomotive construction they should preferably be arranged to give the same range of speeds both forward and backward. Reversing is usually accomplished by bevel gearing. Mechanical transmission requires some sort of a friction clutch and this feature gives trouble on the upper range of power to which mechanical transmission is applicable. It is probable that 150 hp. is the practical limit for mechanical transmission.

Hydraulic transmission—This form of transmission usually employs oil as a power transference medium, and is attractive because of the possibility of infinite speed variations; some designs, however, fail to secure this possibility. Hydraulic transmission is suitable for locomotives of comparatively high power and shows less initial cost than electric transmissions of equal capacity. It has, however, the disadvantage of concentrating its final driving power into one gear wheel, which makes it dependent on tooth contact and pressure. Its limitation is probably in the neighborhood of 500 hp., although its advocates claim adaptability to twice this figure. All designs employ a primary unit, or pump, which supplies oil under pressure to a secondary unit, or rotor. If the stroke of the pistons in the primary unit permits variation from zero to maximum, it follows that variability of speed can be obtained in the secondary unit, which is practically of reverse operation to the primary one. The Hele-Shaw and Lentz transmissions are the best known examples of the hydraulic transmission.

The Lentz system, which is usually considered the most successful hydraulic transmission, does not give infinitely variable speeds, but because of its simpler construction and the lower oil pressures employed, avoids the operating mishaps of more complicated systems. It gives a definite number of primary speeds, and intermediate speeds are obtained by the by-passing of the transmission oil, or by varying the speed of the main motor. As the oil pressures in the Lentz gear do not exceed 500 lb. per sq. in. at starting and average 50 to 150 lb. when operating at speed, leakage is not so serious a matter as with the other types of hydraulic transmissions. Numerous European locomotives have been fitted with the Lentz gear, including four 400-hp. engines manufactured by the Linke-Hofmann Company for the German State Railways. A 60-hp. Lentz engine tested in 1924 on the London and North-Eastern is reported to have given highly satisfactory results within its power limitations.

The Schneider system is really a combination of mechanical and hydraulic transmission, the increased torque required at low speeds being obtained from the relative motion between the rotor and its casing. The energy due to slippage augments the power by an additional torque on the secondary unit. By this arrangement the usual power losses in hydraulic transfer are decreased and the general efficiency of the transmission is improved, especially at the higher operating speeds.

Electric transmission—In this system the prime mover is connected to an electric generator which furnishes current to operate suitably disposed driving motors. Electric transmission gives a continually variable gear, allowing the locomotive to adapt itself advantageously to the speed of the prime mover. It makes driving easy and is readily adaptable to double-end control. The installation is expensive, but from the railway operating viewpoint, is the most attractive transmission. Within recent years quite a few Diesel-electric locomotives have been built in Europe and the United States.

The Diesel-electric locomotive that has attracted most

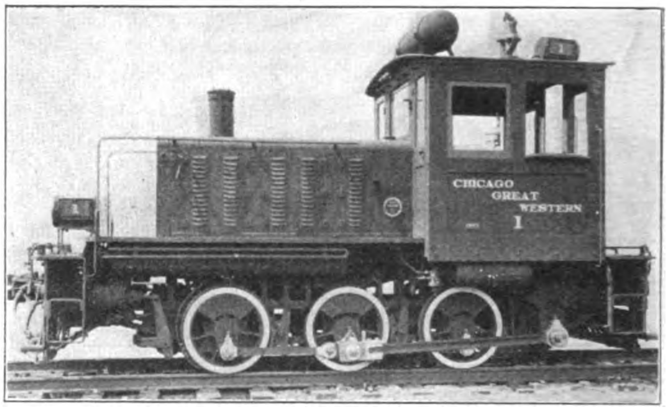
attention in Europe is the design by Professor Lomonossoff, constructed at Dusseldorf, Germany, for the Russian Government Railways. This machine is a unit in the elaborate program of comparison planned by the Soviet authorities. It is of 2-10-2 wheel arrangement, with five motor-driven axles. It is arranged for double-end control, the drivers' cabins being located over the carrying trucks. The engine is a Diesel submarine type, four-cycle, six-cylinder unit, with compressed air fuel injector. Its normal speed is 450 r.p.m.; its maximum power, 1,200 hp. The locomotive unit itself is rated at 1,000 hp., and to verify this rating the machine was thoroughly tested on a special plant, similar to that of the Pennsylvania at Altoona. The generator is of 800 kw. capacity at 600 to 1,100 volts and is directly coupled to the prime mover by a flexible coupling. The exciter, carried on the end of the generator shaft, is itself excited by an auxiliary dynamo operated by a storage battery. A peculiarity of the locomotive is its cooling system, located at one extremity of the structure. The water flows through a piping system cooled by a fan-forced circulation of air; this is quite ordinary and is reported to be sufficient for the cooling requirements during winter and ordinary temperatures. Summer operation in such temperatures as are common in Russian Turkestan, 120 deg. F., will so overload the engine cooling system that a cooling tender must be used which carries extra radiating equipment with fans driven by an auxiliary Diesel engine.

The engine weighs 340 lb. per horsepower. This feature is certainly not in line with the all around utility ideas common with railway men in the United States. The Lomonossoff locomotive was assembled at the Hohenzollern Locomotive Works in Dusseldorf, where tests were made on the roller plant. A comparison was made of these with tests of a Russian type 0-10-0 steam locomotive, oil fired. Dr. Herbert Brown of Winterthur, who personally assisted in these tests, reports an average overall thermal efficiency of 7.43 per cent for the steam locomotive and 26.4 per cent for the Diesel-electric, showing the latter to have been over 3½ times as efficient as the steam locomotive; very significant figures when first cost and maintenance charges are to be considered. Dr. Brown also gives information on the weight of component details entering into the Diesel locomotive ensemble. He estimates that the prime mover, including its auxiliaries, takes about 44 per cent, the total weight of the electrical equipment 30.5 per cent, leaving for the mechanical structure and running gear only 25.5 per cent.

Much further development work on Diesel locomotives is essential

It is my opinion that considerable time must elapse and many millions of dollars be expended in the development of an oil-electric power unit in the shape of a locomotive before machines of this type will figure to any great extent in transportation service. It has many apparent advantages that are not only of great interest to railway men, but which are very seductive to those who do not clearly understand all that is involved. You will have noted that at the present time construction costs are as 2 to 1 compared to steam power. We have all the same thought: if a Diesel engine-driven locomotive as serviceable as the present steam locomotive and as economically maintained in service can be produced, great relief and resultant economy will be obtained by the elimination of ash pits and the various ash-handling devices connected therewith, by the avoidance of the necessity for transferring refuse and the periodical attention required to keep the ordinary steam locomotive in proper condition for service, not to mention the satisfaction that the elimination of boiler explosions, etc., will bring to those men responsible for railroad motive power. It must not be forgotten that these anxieties have been almost entirely removed by proper regulation of the maintenance and use of steam locomotives and the only accidents now being recorded are those due to the personal equation, and which, therefore, can never be entirely overcome.

The internal combustion locomotive unit, whether constructed with direct drive, hydraulic transmission, or electric transmission, is yet in its infancy. The best engineering talent of the world is bending its energy to a successful solution of the problem and we will not know what new difficulties in operation will be encountered or what the anxieties of the future may be in the matter of safety until the actual operation of some appreciable number of engines gives us a thorough experience. The introduction of electric power for transportation purposes has been slow. The expense of installation and the general inconvenience and obstruction incident to its application in service yards and large railway terminals have militated against it; but step by step it has progressed and become a necessity for all underground transportation, or for increasing the volume of traffic handled over such sections of railway as are difficult of operation and on which the use of steam locomotives has reached its limit.



Baldwin internal combustion locomotive built for the Chicago Great Western

If it will be possible for those of us engaged in the development of internal combustion locomotives to produce a satisfactory machine at a satisfactory price to the purchaser, its greatest effect upon the transportation methods of the country will be to further the electrification of railways in general. This experiment is now being tried in Switzerland, as I have previously stated, and if by the use of internal combustion locomotives all branch line service as well as all distributing service at railway terminals, both large and small, can be satisfactorily accomplished, and only main line service by overhead wires or third rails be required, we can then expect a more rapid development in the electrification of our railways. But it will be many years before the steam locomotive, owing to its simplicity, its serviceability and its low production cost, will be relegated to the era of the past.

A CAR BUILT for the United States Army Air Service is designed for transporting helium gas from Fort Worth, Tex., to Langley Field, Va., Aberdeen, Md., and other points where airships may need to have their supply replenished. Three forged steel tanks or bottles are built to stand a pressure of 2,000 lb. per sq. in. and will carry 207,000 cu. ft. of free helium. The car weighs, empty, 197,200 lb. The maker, the Bethlehem Steel Company, is building another of the same kind at its Johnstown (Pa.) shops. The cars, each 42 ft. long, have Westinghouse friction draft gears, type N-11-A.

Some of the Missouri, Kansas & Texas apprentices who attended the second birthday banquet at Parsons, Kans., of the apprentice schools.

Railway apprentice training

Skilled, thoroughly-trained mechanics must be provided—Number of apprentices—M-K-T requirements

By T. C. Gray

Supervisor of apprentices, Missouri-Kansas-Texas, Parsons, Kans.

As an apprentice, I was told a great many times by machinists that I should never tell or show a helper anything that might enable him to learn the machinist's trade. I remember, in one particular instance, while working as an apprentice in a roundhouse, I received a good "bawling out" from a machinist for figuring valve changes on the side of a locomotive cylinder. He informed me, in no uncertain terms, that the first thing I knew all the helpers in that vicinity would be "settin' valves." I thought they must be a bright lot of men. I had labored and studied in the valve gang and figuring valve changes came hard for me. And, I had been taught how to figure them! If these helpers could catch on that easily and quickly, surely, they must have something that I lacked.

I learned after completing my apprenticeship that I must not, under any circumstances, let my helper do anything that might teach him the trade. I must not let him even "start on" any nuts or perform any of the mysterious rites of my trade or he might learn to handle my job. And there were other "must nots" too numerous to mention, which the grievance man made it his business to see were not violated. This grievance man was surely loyal to our trade. He spent the greater part of his time seeing that we lived up to the various rules pertaining to it. I learned later that he had been promoted from the rank of helper during the World War.

I never was in sympathy with such rulings, and took a great delight in trying to show and teach my helper everything within my power. I found that the helper was just as much of a human being as anyone, and should therefore be entitled to the rights and privileges of this great country. I found that he was just as interested in accomplishing and doing and learning as the average man. If I could interest him in the work we had at hand, he accomplished much more than if I tried to hide the "mysteries" of my trade and treated him as if I did not care what became of him.

The railroad mechanic

I have always had the highest respect for my trade. I have respected it too much to believe it possible for anyone to learn it in any other way than by a thorough training of an all-around nature. I am thinking of the railroad mechanic—I know very little about the "contract shop mechanic." I do know, however, that the particular branch of the navy in which I served as a mechanic during the late war sent recruiting officers out to nearby railroad shops to recruit railroad mechanics. And this particular branch required the best of mechanical knowledge and ability, and had nothing to do with the sort of work with which the railroad mechanic was accustomed. This was in the submarine branch of the navy and the work required the operation and maintenance of large Diesel engines. Mechanics trained in the railroad shops proved as valuable, if not more so, than the much-talked-about "contract shop men." The railroad mechanic had been trained in such a way that he understood what was wanted. He knew how to "tackle" any job. He had learned to think and to study the work at hand.

We have some railroad men that do not believe it is necessary and essential that we train mechanics. This is evidenced from the fact that a large number of our roads are not supporting a systematic method of apprentice training. I have wondered if they are not influenced by the outcome of the late labor trouble. Were our railroads able to "carry on" with a new personnel made up of men who had never been in a railroad shop before the trouble? I have heard this opinion voiced a great many times. Is this true? Is this a fair way of looking at the situation? I do not believe it is true. It is true that we had a large influx of green men into our shops at that time. But, it is also true that a large number of mechanics "hired out" on other roads. We have to admit that the difference in trying to "carry on" without enough trained men was surely noticeable. How we prayed for a few "real mechanics." The requirements of the rail-

road mechanic have surely been underestimated since the labor trouble.

Misunderstanding about necessity of apprenticeship

I believe the radical change in attitude on the part of the personnel, since the labor trouble, has had some influence on the question of apprentice training. The situation, before this trouble, had reached the point where shop management was practically out of the hands of the shop supervisors. The petty laws of the union men were many and made the job of the supervisor doubly hard. A great many small jobs that could have been handled more efficiently by one craftsman, required three or even four. We are not troubled with these petty laws and rulings anymore, and I have wondered if the majority of disbelievers in apprentice training are not influenced by this radical change in relationship. I wonder if they haven't overlooked two very important factors in industrial management, personnel and instruction. And I believe the former is a function of the latter.

Every progressive organization is trying to perfect its personnel. There surely can be no better way to do this than by getting good material and getting it young and training it and instructing it along the lines that the particular organization should have it trained. The mechanical department needs trained men and this demands some sort of training system. The present-day apprentice system offers a solution of this most important and vital problem.

Very few railway officials realize the importance of apprentice training or pay any particular attention to the curriculum of the schools on their road. Experience is the greatest teacher in the world and they are in a position to know just what their future mechanics, supervisors and officials should be learning. The regular apprentice serves 832 hours in the schoolroom. A great many things can be learned in this time. Also, a great many hours may be wasted. The apprentice school work should parallel the shop work. More time should be spent in the schoolroom on "hammer, chisel and monkey-wrench" instruction than on the three "Rs." Success in trades-training work may be measured by the amount of interest shown by the apprentice personnel. It is not possible to interest a boy in something in which he can not see any practical value. Too much time is spent on mechanical drawing in the majority of apprentice schools. We do not want our mechanics to be expert draftsmen. They can learn the art of blue-print reading and sketching without spending more than half their time in the schoolroom over a drawing board. The school curriculum is very important and the apprentice instructor who guides the destinies of one hundred apprentices in the schoolroom is entrusted with a grave responsibility.

The apprentice system on the Missouri-Kansas-Texas Lines was organized in May, 1924. We have gone along slowly and deliberately and have met with fair success. We believe that we have some mighty good material in our apprentice personnel. The preliminary home and school training that our boys receive before entering our apprentice ranks is most important. We are very anxious to get the very best material. With this in mind, we are co-operating in every way possible with the boards of education in the cities where we maintain shops. *We hope to have a railroad course in each high school next year.* This will be a lecture course and our representative men will address the senior high school boys once every two weeks during the school year, telling them about the transportation game and what it has to offer young men. We hope to interest some good material which otherwise might not have known of the interests in the railroad game. And we may discourage some boys who had been planning on a railroad career.

What should limit number of apprentices

The number of apprentices in each trade is usually thought of as a function of the number of craftsmen. Is this true? I do not think it should be treated in this light manner. Apprentice training is primarily for the purpose of supplying mechanics and supervisors as needed. This demand is a function of economic conditions. The number of craftsmen needed is also a function of economic conditions, but the training factor should not be forgotten. What is the best way to train mechanics? The apprentice system should be an economic asset. The railroad should be getting third-year value from a third-year apprentice. In order to get this value it is necessary that the railroad establish a systematic shop and school routine for the apprentices. The machinist apprentice should not be started in the valve gang; neither should he complete his apprenticeship on a drill press. In order that apprentices advance along this systematic routine, the hiring of apprentices has to take place at equal and regular intervals. The number of apprentices in each trade is a function of a particular shop's training facilities. A shop can train a certain number of apprentices and train them right. It has a certain number of available apprentice jobs. Economic conditions should not govern the number of apprentices if we have an ideal system. The only thing that should change the number of apprentices is the changing of the shop's physical condition.

Shop instruction is very important. Each shop foreman should be interested and feel his responsibility in the apprentices under his supervision. He should be held responsible for the boy learning the essentials of each step in the shop routine. The essentials should be outlined in order that the foreman will understand what the boy must know when he leaves his particular gang. We claim that we have a shop instructor for every three or four boys. Each boy is given an examination on the shop work just completed when he advances one step in our routine. The shop superintendent knows what grade the boy makes on this test, and if it is a low one finds out whether the foreman or the apprentice is responsible. The apprentice is given a notebook in which he enters all his examinations, problems, sketches, federal rules, standard practices, etc. He is allowed to use this notebook when taking his final examination, but can use no other reference.

Apprentice training should be taken more seriously. We do need trained men on our railroads. If we expect to keep up with the trend of times, for which our great transportation systems are directly responsible, we must not forget the importance of the proper sort of instruction.

We have a printed booklet which we ask each prospective apprentice to study carefully. It is too long to reproduce here but the following extracts from it may be of interest:

> Are you looking for work? What is work? You are probably leaving school and are planning on "going to work." Do you realize the importance of this step? Why are you going to work? Why do you choose the railroad game?
>
> Work is the art of producing movement against some resisting or opposing force. Does this definition mean anything to you? Under the above definition, wouldn't play be work? It certainly is work, but it is pleasant and agreeable work and we do not associate work with play. All play is work and yet all work is not play. You are about to make one of the most important decisions in your life. You are choosing your life's work. If you choose your life's work in such a way that it will be interesting and really be play, your chances of some day holding a responsible position are many. If you should be unwise and foolish enough to

choose your work in such a way that the clock interests you more than your work, that the hours seem long and there are fellows in other lines of endeavor that you envy, you will never rise above the ordinary worker. It is very essential that you be interested in your work. You will be given many jobs that will be hard and heavy and dirty. These will serve as a test. If you are the man you will have to be to some day hold a responsible position, you will go through such tests with "flying colors" and the firm determination that you dare anyone to stop you on your road to success. *Where you will be ten years from now depends entirely on how you apply yourself during the next ten years.*

* * *

We are very proud of our railroad. We realize that it runs through a prosperous and rapidly developing section of the country. We are proud of our modern locomotives and fine cars, and other up-to-the-minute equipment. We are proud of our organization and deem it a great privilege to be a member of the Missouri-Kansas-Texas family. If you should be so fortunate as to be taken into our apprentice organization we shall expect you to uphold our traditions and help us in training you to be a "Katy-man."

Be loyal to your railroad. If you are *loyal* you will not be satisfied to do *fairly well* what ought to be done *very well.*

Among the rules are the following:

Apprentices assigned to special duty, such as test work, will not be required to attend school. No apprentices will be assigned to special duty who are not ahead of the school room schedule and have a good shop record. Upon the completion of any special work the apprentice must write a letter to the supervisor of apprentices, in which he will give a complete description of the kind of work performed and tell how he was benefited by the special work.

All apprentices must attend the monthly apprentice club meeting and endeavor to take an active part in the management of the club.

Probationary period.—During the first six months you will be on trial. This is a probationary period and we will determine in this period whether or not we think it advisable to keep you in our organization. At the end of this period you will be called before the Apprentice Board for its decision as to whether or not you remain an apprentice. At the end of the probationary period the apprentice instructor shall send a letter to his shop superintendent, copy to supervisor of apprentices, saying:

John Doe, machinist apprentice this point, has completed his probationary period and has an average grade in the following items:

School	Effort
Shop	Interest
Mechanical ability	Self reliance
Common sense	Morals
Attitude	Physical
Leadership	Average

In lieu of the above I do (or do not) think it advisable to keep this boy in service.

(Signed) Apprentice instructor.

School routine.—The apprentice will follow our regular school room schedule as closely as possible. The work is so arranged that he will have to work to keep up with our standard requirements. All work has a time limit and the average boy can keep up by putting forth an honest effort.

Shop routine.—The apprentice will be given a routing card when he starts to work. This card will become the property of the foreman under whose supervision the boy is placed. The foreman will fill out the card properly each month and when the boy is ready for a change he is to give the card to the boy with instructions as to where he is to take the card. Proper instructions for handling are on the card. The card will be given the boy at the apprentice school when he returns the indenture properly signed. A similar card will be kept at the apprentice school and in the office of the Supervisor of Apprentices. The Apprentice Instructor shall be responsible for all changes and shall make changes to correspond to our routing schedule as closely as economic conditions will allow, and he will send a list of recommended changes each month to the Shop Superintendent. The Shop Superintendent shall make the changes as recommended.

Monthly shop supervisor's report.—This will be filled out each month by the shop supervisors. It shall be sent to the apprentice school not later than the 10th of the month.

Shop instructions.—Each foreman will be responsible for the apprentices under his supervision and shall be held responsible for the apprentices learning the essentials of each job. In this way we have a shop instructor for every three or four apprentices.

Number of apprentices.—The number of apprentices in each trade will be governed by our training facilities.

Home work.—The apprentice is encouraged to do outside study and reading and subscribe for at least one good mechanical publication. Should he fall behind the school room schedule he must make this up on his own time. No apprentices will be graduated who have not completed the entire schedule, including the final examination.

Helper apprentices.—Men who have had at least two years' experience, or the equivalent of two years as a helper in the work of their chosen trade, may be employed as helper apprentices if approved by the Supervisor of Apprentices.

Special apprentices.—Special machinist apprentices must be graduates in railway mechanical engineering of technical universities. They will not attend the apprentice school, but will follow our shop routine as outlined for them.

Apprentice board.—The Apprentice Board is composed of the shop superintendent, general foreman, machine foreman, erecting foreman, boiler foreman and apprentice instructor. This board is presided over by the shop superintendent and meets once each month. All members of the board are active in their efforts to bring out all matters pertaining to the apprentices. They are particularly interested in those who are in arrears, or upon whom an unfavorable report is made by some member of the board. Delinquent boys are brought before the board, told of their weakness and what is expected of them if they remain in the service. Due consideration is given each boy, but boys found to be incompetent are dropped from the roll of apprentices and not allowed to drag along from month to month. The board not only discusses the qualifications and fitness of each of the apprentices, but takes up any other subjects it feels are of interest and value in the training of apprentices.

Efficiency rewards.—Apprentices who average 95, both in shop and school work, for 12 consecutive months are given 100 hours on their apprenticeship. If an apprentice has an average grade of 90, upon the completion of his apprenticeship, if selected by the Apprentice Board, he may serve an additional year as a special apprentice. This year is similar to the last year served by a special apprentice. Upon recommendation of the Apprentice Board, the apprentice may be given 100 hours for extraordinary work; or have 100 hours deducted from his service for spoiling work or breaking any rule.

Length of apprenticeship.—Regular apprentices shall serve eight periods of 1,160 hours each. Special and helper apprentices and freight car apprentices shall serve six periods of 1,160 hours each.

Apprentice club.—Apprentice clubs are organized at each point where we have schools. All apprentices should take an active interest in their club.

Athletics.—Amateur athletics are encouraged among the apprentices and the physical side of the boy's life is not forgotten.

Get the men interested*

By Harry Gardner

Roundhouse foreman, Chicago & Eastern Illinois, Salem, Ill.

THE way I handle men is to give them just as much freedom as I can as long as it doesn't interfere with the instructions of the company. First, I study the men to try to find what they work best at by changing them from one job to another. And when you get a man interested, try to get him to study his line, and just a little patting on the back and you can save the driving for the man on the job he is not fitted for.

I have known men to work in a blacksmith shop all their lives and never learn to swing a sledge in a proper way. I had several helpers a short time ago that were not good sledgers and the mechanics complained. I showed them what I could about sledging and there was still lack of harmony between the helpers and mechanics. One day during lunch period I bet a man that there was

* From a contribution to the *Railway Mechanical Engineer* competition on the opportunities and responsibilities of the foreman.

not a man on the job that could take a smooth block of wood and hit an overhand blow with a fourteen-pound sledge, and leave a square impression in the wood where the sledge hit. They all tried and failed. But a new spirit arose, and they took a different interest; it was nothing uncommon to find a block of wood all hammered where someone had practiced using a sledge, and they are all good helpers now.

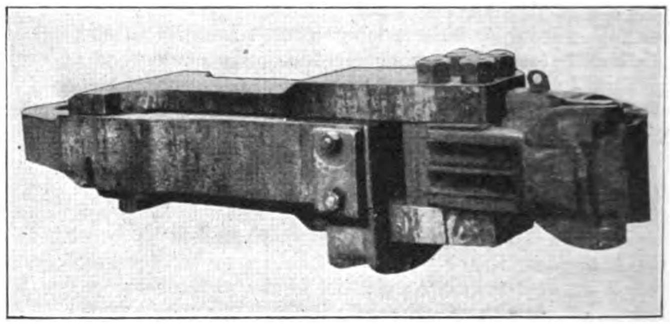
I study out plans of this kind to get the machine-men boilermakers, tank-men, fire-builders, toolroom-men and laborers interested in their work. What I am trying to show is that it is better to reason it out with a man than it is to try to drive him. I always try to put myself in the other fellow's shoes before I criticise him. Honesty is my policy. I have had the officials over me say that I was getting to be a regular lawyer, arguing in behalf of my men. The men the argument arose over would state I was overworking them, trying to put a feather in my own cap and this all in the same day. But a policy of square dealing will get results.

Mechanical design of Virginian electric locomotive

THE undertaking started by the Virginian Railway in 1923 to electrify 134 miles of its main line extending from Mullens, W. Va., to Roanoke, Va., brought with it a problem in heavy traction never before attempted. The road profile shows that between the coal-receiving yards at Elmore, W. Va., and Norfolk, Va., the heavy grades, reaching a maximum of two per cent, are confined to the section between Elmore and Roanoke, and it is on this section also that the curves are severe, reaching a maximum of 12 deg. The capacity of the section between Elmore and Roanoke is in reality the capacity of the entire system and for this reason the railroad has always faced the problem of designing heavy motive power, leading all other roads for size and hauling capacity of locomotives, the electric locomotive being no exception. The hauling capacity rating of the electric locomotive shown in the illustration and built by the American Locomotive Company, New York, and the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., at 30 per cent maximum adhesion requires 900,000 lb. of adhesive weight for the necessary 270,000 lb. tractive force.

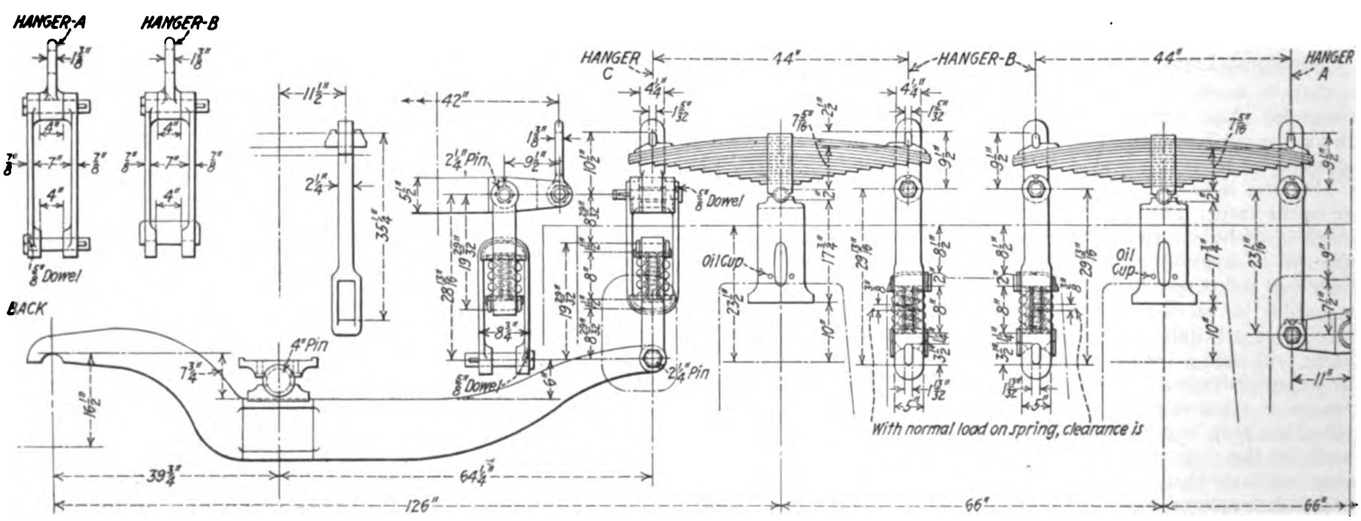
Wheel arrangement

The problem of distributing 900,000 lb. of adhesive weight, and at the same time of providing a flexible wheel arrangement that would successfully negotiate the road curves both in hauling at the front and pushing at the rear of the train, brought out the fact that the 12 pairs of driving wheels must be divided into three section, each section provided with a two-wheel leading and a two-wheel trailing truck and, therefore, the complete locomotive is known as the 282-282-282-E class, the letter E standing for electric.

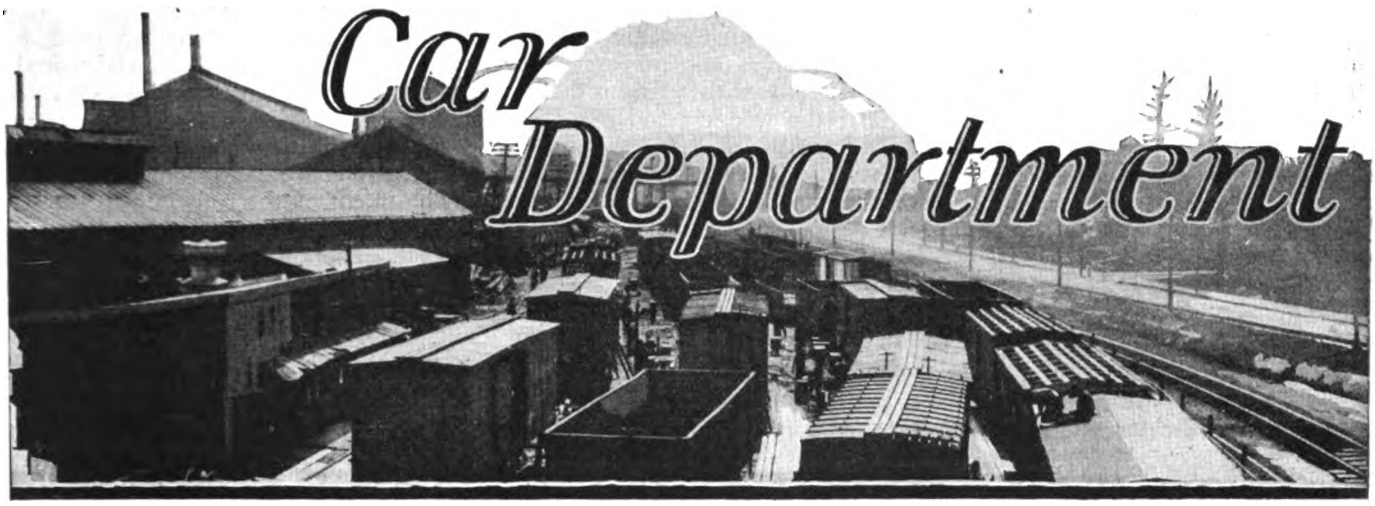


A specially designed draft gear which will sustain a bumping shock of 1,000,000 lb. and a tractive pull of 360,000 lb.

The spring-supported loads on each separate wheel base are carried on a three-point equalizing system; one pair of drivers being cross-equalized with one truck forming the single point, and three pairs of drivers equalized with the opposite truck forming the other two points.



The spring-supported loads are carried on a three-point equalizing system



Lubrication and care of journal boxes*

By M. J. O'Connor
Special lubrication inspector, New York Central, Buffalo, N. Y.

SINCE the advent of friction draft gears, steel underframes, steel ends and solid steel wheels, car failures in trains have been reduced to the extent that today 90 per cent of the failures in freight trains are chargeable to hot boxes. The modification of the A. R. A. Rules, allowing freight cars to be loaded to axle carrying capacity, instead of the 10 per cent above stencilled capacity, compels the car department to use the greatest care in journal box maintenance.

The following methods and practices—which cover maintenance and construction—have proved very beneficial, and it is hoped by the writer, that the methods as outlined will be the means of bringing out further improvements which may exist on some railroad.

Journals

All journals should have a clean, smooth bearing surface; great care must be exercised in the finishing of collars and fillets to eliminate cutting edges.

Wheels on storage tracks should have journals coated with some suitable grease at all times, to avoid rust.

All boxes should be thoroughly cleaned—whether new or second-hand. Where new boxes are applied, it should be the practice to see that all scale and sand is removed. The cleaning of boxes is done very easily by the use of compressed air. Close-fitting dust guards should be applied in all cases where necessary, when removing wheels.

Experience tells us that, as a general rule, these bearings do not fit properly on the journals in the condition they are in when received from the manufacturer; in other words, the bearings have high spots, caused by shrinkage in the lining metal at the time they are lined in the brass foundries. This condition develops as the result of the lining being poured at a temperature 550 to 600 deg. F. and is exposed to an atmospheric temperature of 60 to 70 deg. F. The time consumed in pouring the lining is a prime factor in this respect. The unevenness of the lining in the bearings averages about 1/32 in. To overcome this condition and obtain a bearing that has a crown seat on the journal when applied, the best known practice is the use of a power boring machine to fit these bearings to the journals. The results in the use of this machine have been remarkably satisfactory.

When applying a brass on the journal, its surface should be given a coating of oil. The oiling of the brass consists of pouring from a special 1-pt. or 1-qt. sized can with spout. The oil is poured on the longitudinal side; then the bearing is tilted from side to side, after which the oil is allowed to run over the fillet or shoulder end. By this method we create an unbroken film.

Never wipe the face of the brass or journal with oily or dry waste.

Center plates and friction side bearings

When trucks are assembled or removed for repairs, before replacing them, a suitable lubricant must be applied to the center plate and friction side bearings.

Relining of journal bearings

Bearings found in the following condition when removed from journal boxes should not be relined:

1—Where end wear is more than 1/16 in. on either end.
2—Where the extension back of the lug is worn more than 1/16 in.
3—Where the back or sides show indications of wedge wear—be it only 1/64 in.

With reference to the third cause: We must realize that it is necessary to rebore the bearing side of all brasses, in order to obtain a clean surface, so that the lining will properly adhere to the brass back. Furthermore, when it is considered that the standard thickness of a brass back, when it is new, is only ⅞ in., and we bore out 1/16 in. to get a clean surface, when relining, it can be readily seen that any signs of wedge wear further reduces the thickness and at the same time creates a more weakened condition of the brasses. The relining of all bearings, as outlined, should be done by a brass manufacturer who is fully equipped to perform this class of work.

Journal bearing wedges

This is one of the most important features in connection with the contained parts of journal boxes. Therefore, careful examination should be made of their condition each and every time a brass is changed. For example, a

*Abstract of a paper read before the April meeting of the Car Foremen's Association of Chicago.

9-in. wedge, when new, has a 78-in. radius, which is equivalent to 1/16 in. crown, and it is this crown that properly distributes the weight of the load on the brass, at the same time allowing the brass to slide laterally with the wedge. When the crown is worn flat the wedge does not function properly, as it retards the lateral movement of the brass, with the result that when the bearing reaches the point where the entire surface rests on the journal, the wedge commences to take a permanent set on the brass about ½ in. from the collar end, causing another hot box. It is very desirable that we give as much attention to the condition of the wedge as we do to the condition of the journal bearing when a change of brass is necessary. The drop-forged steel type of solid back wedge is very serviceable.

Periodical repacking of freight cars

The discontinuance of periodical repacking of journal boxes on foreign cars for compensation must have had its good reason, although I feel it should have remained one of the requirements of the rules, as much so, as the periodical cleaning of air brakes, and for this reason, would recommend a proposed new Rule 66 to read as follows:

Journal boxes not repacked within 12 months as indicated by the stencilling on car body.

The date and place (railroad and station) where the work is done must be stencilled on car body near body bolster at diagonal corners in one-inch figures and letters, using the same station symbol as used for air brake stencil.

To justify charge all of the old packing must be removed and boxes cleaned; boxes must be jacked, the bearings and wedges removed for examination and renewed where necessary. Properly prepared packing (new or renovated), must be used and the work done in accordance with A. R. A. recommended practice adopted in 1920.

(Note)—Dust guards must be examined and renewed (if necessary) when wheels are changed.

It will be noted that a safeguard has been placed in this rule to justify the charge.

Periodical repacking of freight cars

It has been found that the removal of journal bearings and wedges for examination is of the utmost importance when boxes require renewal of journal box packing. During the past year this has been fully demonstrated because in repacking more than 50,000 freight cars, the stencilling on which indicated such cars had not had the bearings, wedges and packing examined anywhere from one to four years, it was found necessary to renew 25 per cent of the journal bearings on all such cars on account of the following defects:

The extension back of the lugs—½ in. wide when new—was worn ¼ in. on half the bearings renewed. This condition had distorted the brass back to such an extent that the babbitt metal had been drawn over the longitudinal edge of the bearing.

One-quarter of the bearings renewed were removed on account of excessive end-wear. When we say end-wear, this indicates a wear on either end of more than ⅛ in.

One-quarter of the bearings renewed were removed on account of worn through lining and lining cracked; this condition being due principally to mongrel types of wedges, as well as solid wedges worn flat. In other words, these wedges were not functioning properly.

The method of preparing packing with the ratio of four pints of oil for each pound of dry waste, is in my opinion, universal. So we will now go into the matter of saturation. Saturation consists of forcing the air out of the waste fibres and the oil in. Therefore, it is necessary to heat the oil to some extent in order to create expansion, so it will work its way into the waste, forcing the air out. This makes it necessary to keep preparation and storage tanks hot at all times. All tanks—whether used for preparation or storage—should be made of metal, for the reason that metal is a conductor of heat, and wooden vats and tubes are not.

The use of prepared rolls in the back of journal boxes is very valuable. These rolls are 2½ in. in diameter and 10 in. in length. The intent of the rolls is to better exclude the dirt and keep the oil in journal boxes, and not to lubricate the journal. Therefore, precaution should be used in properly placing the roll at the back of the journal box to avoid one of the ends working upward against the journal at the shoulder.

Method of applying journal box packing

Place the roll in the mouth of the journal box, work it back under the journal to the extreme back of the box, leaving it in such a position that it does not extend above the center line of the journal. The rest of the packing should then be placed under the journal firmly so as to prevent settling away. This is best accomplished by placing the packing across the full width of the mouth of the journal box and allowing the strands to hang down outside, always adding more packing before placing the hanging strands inside the box. This has the effect of binding all the packing in one mass. The packing must not extend above the center line of the journal or beyond the inside face of the collar.

The method of packing journal boxes, as outlined, is the best known preventive of the so-called waste grabs, which is the cause of more than 50 per cent of the hot boxes on freight equipment.

Care of packing in journal boxes

The most important part of the work for successful lubrication of equipment, is intelligent attention to the condition of the packing in the journal boxes in train yards. The handling of this work consists of placing the packing iron along the sides of the journal box, then pulling the packing forward from the sides and working it back under the journal at the center; if additional or new packing is required, it should be worked back under the journal from the center, care being taken that it is not lifted above the center line of journal on either side.

The handling of this feature, as outlined, has produced splendid results, particularly in journal boxes where the so-called front plug is *not* used. It is a very difficult matter to maintain packing below the center line of the journal where the front plug *is* used, as it seems to be second-nature with car oilers to force it under the journal.

The practices which have been outlined can only be accomplished where standard printed instructions in book form exist, plus standard tools and equipment, as well as a supervisor, to follow the matter at all times.

Furthermore, we all realize that there have been suggestions, recommendations, and many good points brought out with a view of protecting equipment from giving trouble, and running hot by new devices, but we all feel, I think, without question, that our present method of lubrication is one that will continue with us for some years to come. Such being the case, let us all work together to bring it to the very highest standard.

The Boston & Maine, in an effort to further increase its fuel savings, which amounted to 42,236 net tons in 1925 as compared with 1924, has established a budget system, by which coal consumption is measured by operating divisions in tons and pounds per unit of service, just as the general expenditures of the road are budgeted in dollars and cents. Each division superintendent is responsible for his share of the coal budget, the figures of which have been based on a reduction of five per cent from the consumption unit of last year.

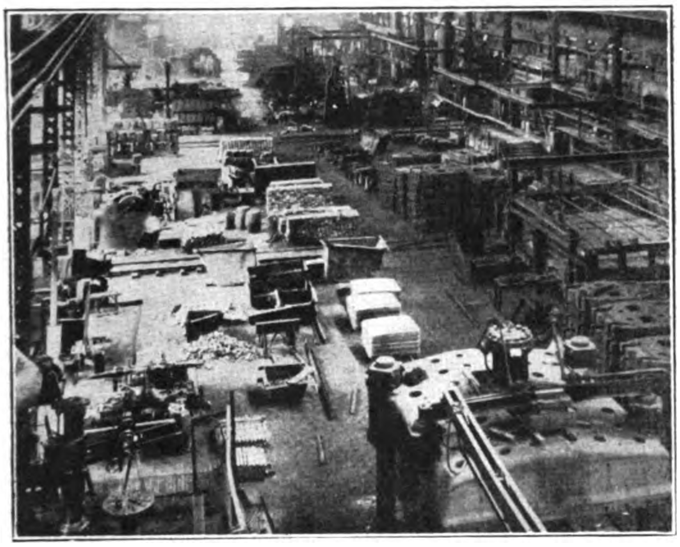
Century of car manufacturing progress*

Comparison of methods used in 1835 with those of today—Progressive steps for manufacturing a composite box car

By George A. Richardson
Manager, technical publicity department, Bethlehem Steel Company, Bethlehem, Pa.

NINETY years ago, or, to be exact, in 1835, three ambitious young men made an extensive and exhaustive investigation of the methods then used by manufacturers of stage and railway coaches throughout the New England section. Railroads still were a new, though a promising possibility. They found that most of the shops were merely frame sheds in which the rough, old-fashioned four-wheel cars were being constructed.

As might be surmised, all three young men were of a progressive turn of mind. They believed there was room for marked improvement in the more or less primitive methods of building the equipment, as well as in the arrangement of the plant required. Two of the young men, Mahlon Betts and Samuel N. Pusey, formed a partnership for the purpose of building railroad cars. This was in 1836. Erection was begun on a three-story brick building at the corner of Front and Tatnall Streets, Wilminton, Del., and production soon started. A year later, Samuel Harlan, Jr., who had been the third member of the investigating party, was taken into partnership.



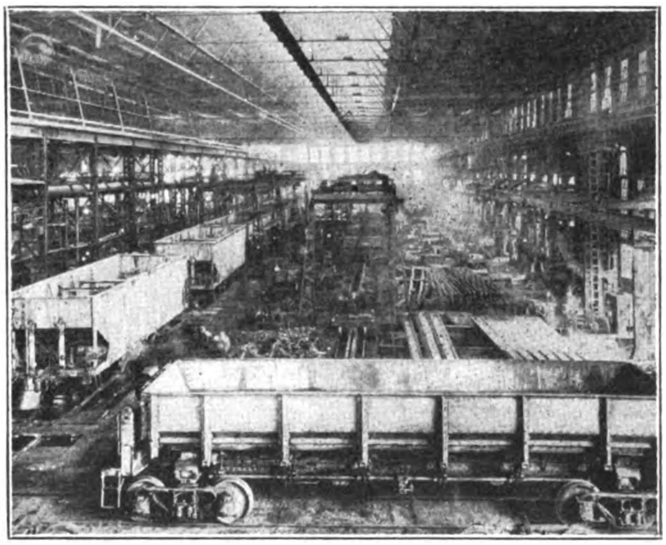
Interior view of the forge shop at the Cambria car plant

This was a period of transition. The original idea of using modified stage coaches for cars was being gradually discarded and, within a couple of years, we find the beginning of the modern style of car building.

Facilities of one of the first car manufacturing shops

The new building erected by the partners little resembled a shop used today for manufacturing railroad cars of any kind, and yet it sufficed to take care of the available business of that time and was considered an up-to-date plant. In the basement were placed the blacksmith fires, at which the iron was forged for the cars which were built on the upper floors. Here, also, the trucks were framed and finished in a small area divided off from the rest of the floor space. On the first, second, and third floors the business of car building was carried on in all its branches. The few woodworking tools of the day, with work benches, were distributed mostly about the second floor, while the upholstery room and other divisions of the business occupied the remaining spaces not required for the erection of car bodies.

The floor of the second story of this shop was laid in large traps, through which the completed cars were lowered by blocks and falls to the ground floor where they were painted and varnished for delivery. The entire building was 60 ft. wide by 100 ft. long, but the standard car length of that time was only about 32 ft. so that plenty of room was available.



Interior view of car shop No. 2, located at Jonhstown, Pa.

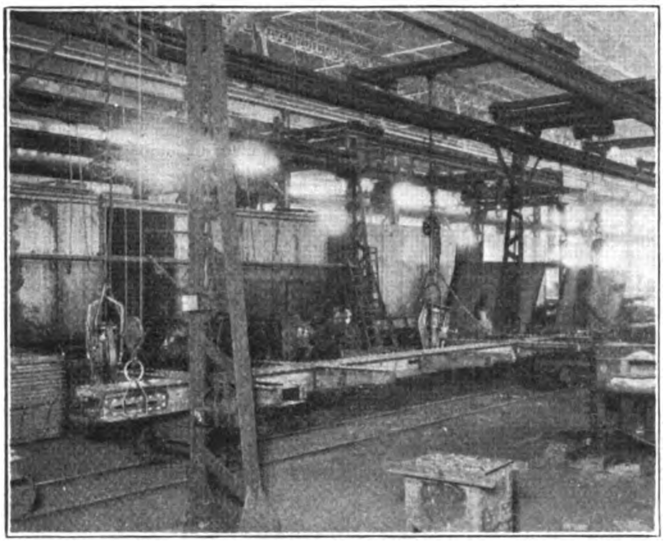
The new firm built in the first couple of years of its existence 109 four-wheel cars and 67 eight-wheel cars, a good record considering the facilities available, but one that, considering the size and design of the cars, would amount to little today. The plans were little more than rough water color sketches bearing, for the most, a few major dimensions, everything else being left to the builder. This concern not only made a bid for local business, but also published a very elaborate circular in 1839 for the purpose of advertising to foreign countries, and were suc-

* Abstract of a paper presented before the February 12 meeting of the St. Louis Railway Club.

cessful in acquiring considerable export business also.

From these early pioneer days to the present, as a result of a rapid increase in tonnage and the consequent problems confronting the railroads, the change in type and capacity of equipment has been going on continuously and even at the present much is being done in the way of simplification, efficiency and increased carrying capacity of the equipment.

Unit production, by necessity, has given way to mass production, and this is particularly true in the case of freight cars. As a matter of fact, we find it desirable to segregate passenger car work because of its highly specialized character and demands for finish, which call for a great amount of time. Hence, we find that the old firm



The method of riveting the underframe of a steel box car

of Betts, Pusey and Harlan, which, after passing through several changes in organization during the course of which it was known for a long time as Harlan & Hollingsworth, was finally acquired by the Bethlehem Shipbuilding Corporation in 1911, and came gradually to specialize on passenger car building, and still continues to do so.

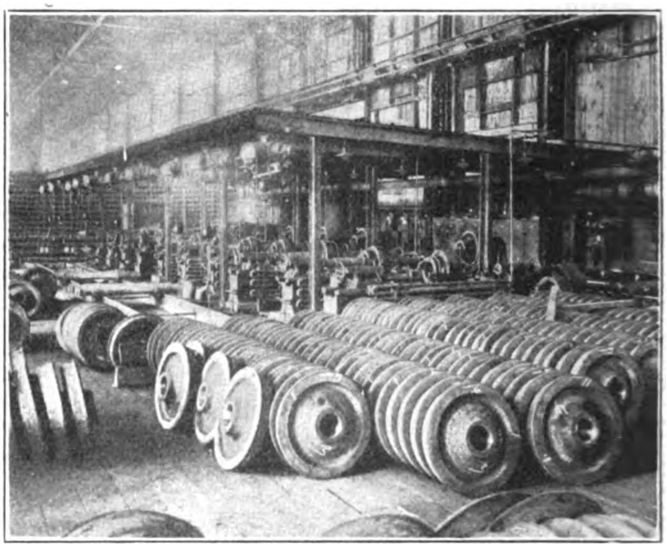
Essential factors to be considered in a modern manufacturing car plant

The freight car is one of the big factors in railway transportation, and it is in the building of this equipment that the problem of mass production is the most important. The present generation remembers 20 and 30-ton capacity cars, and the rapid change from those to the present types of 50, 70 and even 100 and 105-ton capacities in some cases. Notwithstanding this great increase in car capacity, the total number in service has increased much more rapidly.

Started about 25 years ago, the productive capacity of the Cambria car shops located at Johnstown, Pa., has increased until today nearly 100 cars of various kinds can be built every 24-hour day. Originally the work was confined to steel cars of certain types, but with the changes in capacity, provision has been made to handle any type of car for freight service, whether all-steel, wood or composite. Low cost is a result of mass production. Most persons are familiar with the production methods in the automobile and similar industries, but do not consider the building of freight cars a problem of mass production. It is a matter of fact, however, that methods prevail in the building of freight cars identical with those in the manufacture of automobiles, modified only to meet local conditions.

Proper facilities for the storage of materials are important. The flow of materials must follow the same channel regardless of the type of car being built. The endeavor of a large producing organization giving its time and energy to the single purpose of freight car production can be likened to an automatic machine in which each movement follows the preceding one with regularity and exactness. Starting with immense stores of raw materials, many hands and numerous machines transform the inert masses into a symmetrical and useful commodity.

In the modern car shop one witnesses a feat which is impressive. One sees the various parts moving rapidly together and combining with the regularity of clock work into one whole in a length of time almost inconceivably short. Imagine for a moment that in the Cambria car shops one freight car is completed every 15 min. during the working day, and that this rate is kept up day in and day out during the entire time the current order lasts. It is fascinating to see the various parts going together and moving from position to position. Starting from the very beginning the immense piles of raw materials are transformed into trucks, underframes, bodies and complete cars with a dispatch that would have seemed marvelous 20 years ago. This rapidity is due to a complete and careful subdivision of work into position operations and the concentration of the maximum amount of labor that can be used most economically in every position. Often 1,000 men are employed in the two erection shops at Cambria.



The axle turning department is covered by an overhead structure which carries an electric monorail and hoist for every machine

The Bethlehem Steel Company is in a unique position as regards the manufacture of cars, because it is the only plant of its kind in the country that produces the materials for car manufacture, as well as building the cars themselves. This includes such diversified products as bolts, nuts, rivets, plates, shapes, rolled steel wheels, axles, and pressed and drop forged parts.

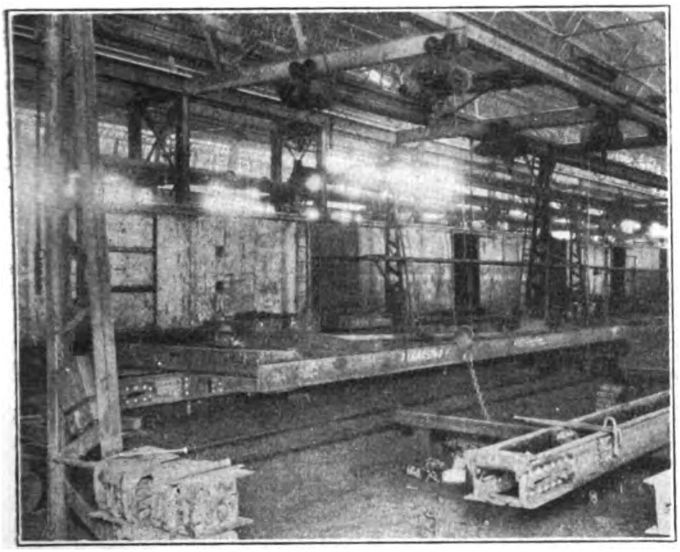
The entire car shop division has been laid out with a view to obtaining, as nearly as possible, a constant flow of material from the production and assembling divisions to the erection positions. Not only this, but the splendid results which are being obtained today are the outcome of a well thought-out, systematic and scientific plan of action in which numberless striking changes in methods have been introduced.

Various units of the Cambria car shop

One of the very important units is that made up of the

axle-finishing and truck building departments. These departments produce essential units, which, together with parts from other sources, converge to a common center where the cars are erected. An interesting feature is the housing of these departments and, particularly, the storage of the various parts used by them of which we mention axle, side frames, bolsters, etc. All this material is placed under cover. The housing consists of a modern steel and brick building 90 ft. wide by 740 ft. long, which affords ample space for the storage of all parts and of all machines entering into the manufacture of the trucks.

Approximately one-half of the total area of this building is given over entirely for storage purposes. A standard gage track extends the entire length of the building



The jig used in building the underframe of a steel box car

and has a capacity of 15 freight cars at one time. Three 10-ton overhead traveling cranes provide the necessary facilities for unloading material directly from the cars to the stock piles without rehandling.

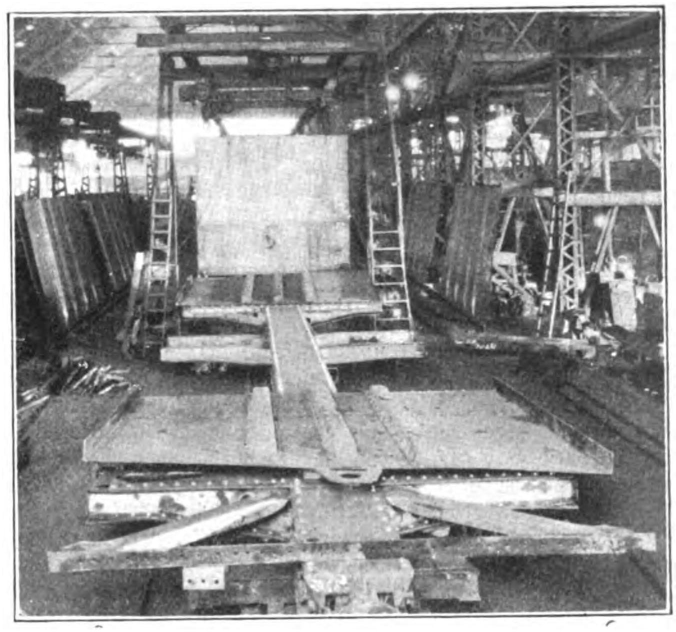
The various parts are piled in a safe and orderly way. The storage space is equipped with beds made from heavy 20-in. I-beams set in the floor. These steel beams afford a suitable foundation for storing heavy material. It has been found that these beams will just fit a 33-in. freight car wheel when the wheels are piled within the flanges of these beams. This method of piling guarantees the alinement and stability of the wheel piles and at the same time makes it possible to build up very high piles, thus giving a large storage capacity with minimum use of floor space.

The beam beds also afford an excellent foundation for the piling of axles, side frames, truck bolsters and other material entering into truck construction. When axles are being stacked, hardwood stringers are inserted between the layers, with bent steel flats placed at the end of the piles, thus allowing each layer of axles to be of the same length. This method prevents the slipping or rolling of the axles and allows them to be piled high with safety even though the ends of the piles are vertical. Wood stringers are also used in the piling of side frames, bolsters, etc., as a regular practice in order to make the piles safe. As an additional precaution, a slight camber is given to the piles by the proper placing of the stringers.

As a result, one will find an unusually orderly appearing storage layout not at the expense of, but in conjunction with the very decided advantages of increased safety. Greater storage capacity has been provided. Another feature which has not yet been mentioned is the ease of taking inventory. Passageways are provided between the various piles, and this makes it possible to take inventory very rapidly and accurately.

Method of handling axles

The axle-turning department is provided with 12 modern axle finishing lathes. This department is covered by an overhead structure which carries an electric monorail and hoist for every machine. The rough-turned axles are deposited by cranes on a storage bed from where they are transferred by the above-mentioned hoist into the lathes. As the axles are finished, they are transferred directly from the machines to another storage bed at the head end of the lathes by the same hoist. Here the axles are inspected, gaged and rolled to the end of the bed where the wheels are loose-mounted on the axles by means of a monorail and suitable hoist. The assembled wheels and axles are then rolled from this position on steel floor plates of suitable width to a 600-ton mounting press. After the final mounting, they are rolled to the end of the truck building bed where they are picked up by a small hoist and deposited on rails for the final truck assembly. An important aid in securing production in cold weather is the provision of ample heating facilities which are particularly necessary on account of wet cutting. The indoor storage of the axles and other parts is also a very decided advantage during the winter months. It is a further source of saving time because the workers do not have to contend with the parts being covered with ice and snow, which would be the case when outdoor storage is used.



Sixth erecting position—After the transfer of the underframe the steel ends are applied in this position

Car wheels are finish bored, gaged and marked in this shop. Properly selected wheels are then rolled to the end of the axle finishing bed, where they are loose-mounted on the axles, as described above.

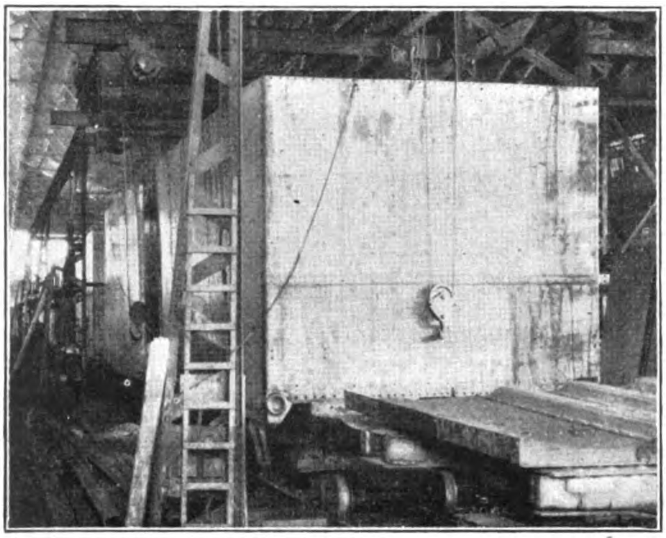
The truck building

The truck building bed is mounted on a cement foundation with heavy I-beams supporting the rails. The top of the rail is approximately 17 in. above the floor lines, which affords a comfortable height for the truck builders. The bed is built on a one-half of one per cent grade, which permits of an easy movement of mounted wheels and trucks. At the end nearest the wheel mounting press double rails

are provided, which permit the over-lapping of the mounted wheels, thus giving greater capacity per unit of length. As the mounted wheels approach the point where the truck building begins, these double rails converge to a single rail system by means of an automatic switch.

Side frames, spring planks, bolsters, etc., are assembled on beds adjacent to the building track and the completed truck frames, which can be considered as a subassembly, are then swung onto the building bed by means of overhead jib cranes and electric hoists.

On the building bed the trucks are assembled and fitted under a position system, constantly approaching the exit where, after the journals have been packed and the trucks



Seventh position showing the erection of the sides and ends

inspected, they leave the building bed on a sharp incline and roll by gravity to the car erecting shop.

Bolt and nut and forge shops

Space does not permit of describing in detail the work and equipment of the bolt and nut and forge shops. Suffice to say that everything is laid out in a manner to insure the most efficient operation, and some very unusual jobs have been and are being performed. One interesting example of drop forging practice is the making of drop forged steel center plates under a 27,000-lb. hammer. In the way of pressed steel parts a great variety of unusual shapes, normally made as forgings, have been developed. A few of the more complicated types are pieces such as pressed steel striking plates, bath tub bolsters, posts of various kinds, etc.

The bolt and nut and forging departments are not only laid out with a view to securing a plentiful and uniform flow of material, but at the same time they are prepared to handle outside jobs in addition to the work normally called for in the operation of the plant.

Operations in the erecting shop

While the preparation work is going on, the cars are being erected as rapidly as possible in the erecting shop. Two sets of erecting tracks are used in the steel shop, so that two cars are being built simultaneously. The cars are moved up one track and down the next, so that the complete body is built in 12 positions. It is then so located that it can be lifted by a crane to the trucking tracks where it is placed on the trucks. The routine of assembly followed in building a steel box car with inside wood lining is as follows:

Position 1—Units for center sill assembly are brought together here and riveted.

Position 2—Center sill is assembled and mounted on building trucks.

Position 3—Crossbearers, bolsters and end sill diagonal braces are applied.

Position 4—Riveting position. Above parts riveted.

Position 5—Draft gear, couplers and miscellaneous parts of underframe applied.

Position 6—Riveting position. Also turnover position. Underframe is turned over in order to complete riveting of all of the assembled parts.

Position 7—Ends and sides assembled. Door jig applied. Body squared up.

Position 8—Application of roof.

Position 9—Riveting position.

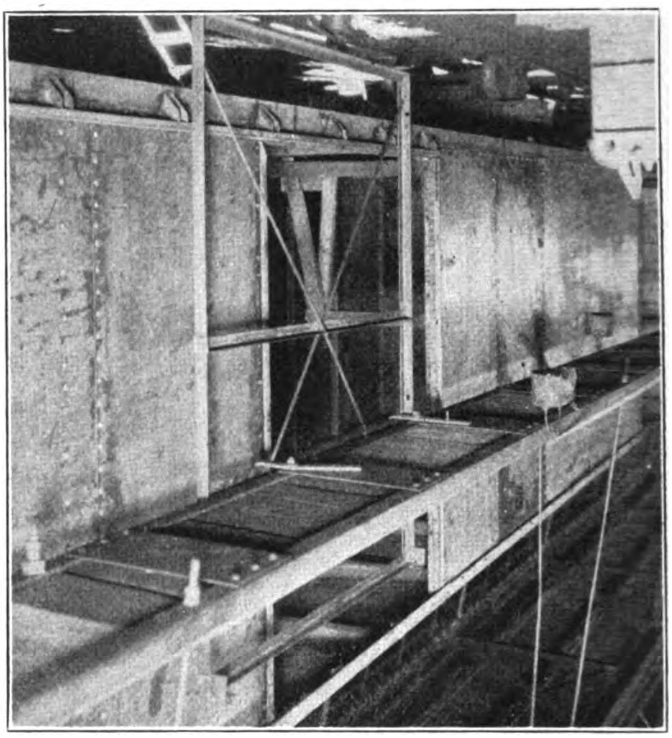
Position 10—Riveting position.

Position 11—Doors applied.

Position 12—O. K. position. In this position all work is carefully inspected, defective rivets replaced and such other corrections made as may seem necessary. The body is carried by a crane from here to the trucking track.

Positions 13 *and* 14—Trucking track. The body is placed on trucks, air brake applied and inspection of air brake.

The car is thoroughly cleaned by washing. A first coat of paint is given inside and out. This includes roof and the spraying of the trucks. The body is then ready for the wood application, which in the present case consists of a wood floor and single lining, extending to the top of the car. This is done in the wood erecting shop where wood working machines prepare the lumber. All parts to be applied to the car are made in this shop, in-



Eighth erecting position of the building of a wood lined steel box car, showing the jig for the correct application of the door posts

cluding running boards and card boards. These all receive a coat of paint before being applied to the car.

Here again position work is an important factor in securing production. The cars are brought from the steel shop and enter the wood erecting shop at the lower end. The cars are moved forward from position to position as follows:

Position 1—Lay flooring. This is more difficult in the present car than normally would be the case, on account of the necessity of having to cut and trim around the posts in order to make a tight joint. One of outstanding features of the handling of this job in the Cambria shops is the care taken to get an absolutely tight floor. About every four feet the boards are wedged into place and held

by bolting down one board. The first gang of men lays the floor as far as the door posts.

Position 2—Continuation of floor laying. Threshold or door opening boards placed. This work is performed by a second gang which follows right on the heels of the first. This gang lays the boards in place and wedges them apart at the center. The loose boards on both sides are cleated temporarily and the resulting gap is measured. A board is then planed to a width about 1/8 in. wider than the width of the gap. The wedges are removed. The two cleated groups of boards are lifted to a pyramidal position, the key-board inserted, and then, with the aid of large levers, the flooring is forced into place. In this way a tight fit is obtained.

Position 3—Laying out floor for drilling for floor bolts. This is done by a layout boy with the aid of templets.

Position 4—Drilling holes for floor bolts. Two drillers with electrically-driven drills do this job.

Position 5—Placing and tightening up floor bolts. After the holes have been drilled, two men apply the bolts. At the same time a gang underneath the car is aplying the nuts and screwing them tight.

Position 6—Grain sealing. This is done to prevent any possibility of grain leaks. A worker pours a hot asphaltum base sealing compound all around the edges of the flooring. He is followed by another man with a hot calking tool which is used to push the excess compound back into place. This is done with a special tool provided with a light and an electric heating coil, which heats the compound to the desired temperature.

Position 7—Apply posts. This job consists in applying the side posts and bolting them up. The gang, consisting of six men, applies over 600 posts in 10 hours, or, in other words, an average of more than one post a minute.

Position 8—Side lining boards and end lining boards are applied and wedged into place. Nailers follow and nail the boards.

Position 9—Door post facers apply posts and bolt them in place.

Position 10—Cleaning and inspection. The car is swept out and a company inspector goes over the whole job carefully.

While this work has been going on inside the car, the running boards and card boards have been applied to the outside. It should also be borne in mind that while all work is inspected by the shop's inspector, it is also constantly being inspected by the railroad company's representative.

From the wood erecting shop, the cars are transferred to the paint shop where they receive a second coat of paint. They are stenciled again, offered for inspection by the railroad inspectors, given an air brake test and finally shipped out.

While position work is a large factor in speeding up mass production, it should be borne in mind that the secret of the uniform and rapid rate of production obtained at Cambria shops without sacrificing quality, is in some measure due to the use of jigs and templates. One will find an extensive use of jigs in the manufacture of roofs, doors, bolsters, running boards and other parts, so that every part fits corresponding parts without any time being lost in fitting and adjusting. Even the quarter sections of the sides are jigged.

Another factor which makes for large production and at the same time makes it possible to make a product of high grade is the extensive use of gage and multiple punches.

Although time did not permit of any description of the facilities of the tank car shop, it is interesting to know that among the more interesting and unusual equipment available are two 23-ft. bull riveters and a set of bending rolls which are used for rolling plates. The top roll, which has a length of 48 ft., weighs 73 tons.

Preparing trains for the descent of grades*

By W. G. Peck

Supervisor of air brakes, B. & O., Baltimore, Md.

THE Baltimore & Ohio, serving the mountainous sections of Pennsylvania, West Virginia and Maryland, occupies the unique position of having more heavy grades than any other railroad in this country, if not the world. There are actually 170 grades of 1 per cent or greater, one mile or more in length, on the 5,196 miles of road comprising this system.

The main line of the Baltimore & Ohio divides at Cumberland, Maryland; one road going northwest to Connellsville, Pittsburgh, Cleveland and Chicago; the other bearing due west to Parkersburg, Cincinnati and St. Louis. Cumberland is at the foot of the mountains and has an elevation of slightly over 600 ft. The west end of the Cumberland division is on the line to Cincinnati, and extends from Cumberland to Grafton, W. Va., a distance of 102 miles. There are two heavy grades on this line sloping eastward in favor of traffic, known as Cheat River Grade and 17-mile Grade. Cheat River Grade is 4 1/4 mi. long, the gradient ranging from 1.9 per cent to 2.1 per cent—17-mile Grade ranges from .6 per cent to 2.28 per cent.

The Connellsville division extends from Cumberland to Connellsville, Pa., a distance of 92 mi. The heavy descending grade slopes eastward in favor of traffic. It is known as the Sand Patch Grade and is 19.5 mi. long. The ruling gradient for this portion of the line is 1.7 per cent.

Coal is the principal commodity hauled on these divisions. Coal trains on the Connellsville division average about 70 cars in length. On the Cumberland division, about 35 loads of coal is the limit, due to the heavy ascending grades which must be negotiated. Trains of meat, stock, grain, structural steel and merchandise are hauled up to 100 cars in length. Traffic is normally congested on both divisions.

Prior to the year 1919, these trains were all handled down the heavy grades with air brakes supplemented by hand brakes. On coal trains, from 50 per cent to 75 per cent of the hand brakes were used. On trains of lighter lading, a smaller percentage of hand brakes were used, although not in direct proportion to the weight as the allowable speeds were higher.

In the spring of 1919, six tests runs were made on each of the Sand Patch and 17-mile grades to determine the feasibility of handling trains without the use of hand brakes. The first test on Sand Patch Grade was made on March 27, with train No. Extra East 4267, loaded with grain, 71 cars. A total of 127 man-hours was required to prepare the brake equipment on the cars. Each brake was required to pass a two-minute retaining valve test.

Following is an itemized list of repairs and material

* Abstract of a paper presented at a meeting of the Cleveland Steam Railway Club, April 5, 1926.

used in connection with putting the air brakes in suitable condition:

5 Packing leathers applied.
3 Triple valves applied.
15 Retaining valves applied.
6 1-inch union gaskets applied.
10 1-inch union gaskets tightened.
29 Brakes adjusted on account of improper piston travel.
15 Air hose applied.
12 Air hose gaskets applied.
1 Cross over pipe repaired.
4 Cross over pipes tightened.
10 ⅜-in. unions tightened.
6 ⅜-in. unions applied.
4 Retaining pipes tightened.
2 Retaining pipes renewed.
3 Angle cocks applied.
3 1¼-in. couplings applied.
3 1¼-in. couplings tightened.
1 Dead lever guide applied.
12 Cotter keys applied.
1 Air brake pin applied.
1 Pipe clamp bolt applied.
1 Brake chain applied.

The first test run made on 17-Mile Grade was known as Extra East 7124, April 15, 1919, with 70 loads of coal. It required a total of 175 man-hours to prepare the train and the following work was performed:

14 ⅜-in. union gaskets applied.
37 Air hose applied.
4 Packing leathers applied.
34 Retaining valves applied.
7 Air hose gaskets applied.
4 1-in. union gaskets applied.
2 1¼-in. union gaskets applied.
2 ⅜-in. unions tightened.
5 Angle cocks applied.
1 10-in. cylinder gasket applied.
1 1-in. union applied.
1 1¼-in. sleeve applied.
1 Set 1¼-in. threads cut.
1 Triple valve cap tightened.
14 Brakes cleaned, oiled, tested and stencilled.
3 J-M expanders applied.
1 Brake cylinder head tightened.
4 1-in. nipples applied.

After the twelve test runs were completed, it was found that power brake operation at Connellsville would cost $1.50 per car, and at Grafton $2.00 per car. Labor was then figured at 55 cents an hour.

Notwithstanding the heavy expense involved, and the fact that level-grade roads could not be forced to assist in bettering air brake conditions, power brake operation was gradually started in 1920 on Sand Patch Grade. Seven hundred and thirty-eight trains were prepared for power brake operation out of a total of 4,290. During 1921, 3,178 trains out of a total of 3,967 were specially prepared for power brake operation on Sand Patch Grade. During 1922, this increased to 4,484 out of 4,683. Power brake operation descending 17-Mile Grade was inaugurated early in 1923. During that year 11,080 trains out of a total of 11,339 were handled by power brakes alone. During 1925, 32,830 trains comprising 1,390,952 cars descended the heavy grades on these two divisions without the use of hand brakes. Four trains failed, that is to say, something occurred en route which led the crews to set a few hand brakes. There has been but one runaway under power brake operation and this did not result in a derailment. One of the grades mentioned starts in the middle of a long tunnel. A passenger engine was being broken in on a freight train. The engineman listening to the exhaust of his high-wheeled locomotive in the tunnel turned the summit at about 15 m.p.h. too fast. He applied the brakes leaving the tunnel, whistled for hand brakes when he realized the excessive speed and was stopped in something more than a mile.

As to the cost of preparing the cars for the descent of these grades and the number of carmen required in the transportation yards for this work exclusively, the latest figures available are for February, 1926, when the net cost per car was less than eight cents. A total of 58 carmen are used, divided among four stations. All trains descending Sand Patch Grade must either pass through Somerset, Pa. (which is on a branch line) or Connellsville. Trains descending 17-Mile Grade are prepared at Grafton or Fairmont, W. Va. When prepared at the latter station, they are main-tracked through Grafton.

It is not necessary to prepare each individual car in these trains. It was found by experiment that 120 tons per good mountain brake could be handled down Sand Patch and 95 tons down 17-Mile Grade with a good factor of safety. If the tonnage per good mountain brake exceeds this, the train crew will refuse the train until further repairs are made. For our purpose, a good mountain brake is considered to be one that, with the retaining valve handle in holding position, the brake will be held applied for 2½ minutes and a good blow of air will exhaust from the retainer when the handle is turned down.

The method of performing the work on the car is as follows: After train is made up, each carman is assigned an equal number of cars, for which he is responsible. The yard air line is connected and the train thoroughly charged. While this is taking place the men inspect for brake pipe leaks and make a general visual inspection. When these defects have been corrected, retaining valves are placed in holding position and brakes fully applied in service. A whistle is sounded as a signal to the men. The brakes are immediately released. Each carman times with his watch for 2½ minutes after the nearest retainer vents and then starts over his cars turning down retaining valve handles. Those giving a good blast of air are left with the handles down, while those giving a weak blast, or no blast are considered ineffective brakes and the handles set up again. The men are allowed to turn down retainers as the triple valves are being moved to application position. They wait again for 2½ minutes before they resume the turning down of handles. This procedure is kept up until a signal is passed to the man at the yard line connection that the test is complete. Each car passing the test is marked with crayon at the retaining valve showing station and date. Work is then started on the individual brakes which did not pass the test, or that required piston travel adjustment. The defects are found on these cars by cutting out the brake and applying it by loosening the triple valve union or cylinder cap. Using this method the men do not interfere with each other's tests. When it is necessary to change a triple valve or clean a brake cylinder on a foreign car, this is done and no bill rendered.

The workmen endeavor to give the trains to the transportation department in two hours. Usually, this is done, but if work is slack or there is no power or crews available, the cars are worked on until all of them will pass the retaining valve test.

Even this does not complete the work. On the arrival of the road engine and train crew, a retaining valve test of the entire train is again made under the supervision of the conductor. Each brakeman reports to the conductor the number of inefficient brakes he finds and the conductor figures the tonnage per good mountain brake and has it checked by the engineman. In arriving at this result, gross actual tons are used, and the brake conditions noted in the train book. If the maximum tonnage per good mountain brake is exceeded the conductor refuses to take the train.

To the diligent efforts of all railroads to improve freight car brake conditions, we owe in large measures the success of power brake operation in descending mountain grades.

THE TERMINAL RAILROAD ASSOCIATION of St. Louis exhibited at the St. Louis Union Station on April 12, a new locomotive built at its own shops for handling transfer traffic between the carriers connecting with the terminal. This locomotive in working order weighs 422,500 lb., and has a tractive force of 60,335 lb. It is one of twenty of its type added to the terminal equipment.

Preparing freight cars for products damaged by odors

ONE of the problems with which railroads are continually confronted is that of cleaning freight cars which have previously been used for shipping fertilizer, packing house offal, fresh hides, glue stock, guano etc., so that they may be used for carrying grain, butter, flour, etc., without any of these materials becoming contaminated.

The data which follows was based on a series of tests closely observed by railroad officers. Freight cars which had been used for different types of shipment were selected for the tests. For example, one freight car had been used for shipping bulk bone fertilizer. The walls and floor of this car were heavily coated, and the odor

Deodorizing a car by means of steam and a cleaning solution

remaining from the fertilizer was very offensive. The car itself was in good condition, the walls and floor being unbroken.

Another test was made on a car that had contained glue stock, guano, hides, etc. This car was not in as good condition as it might have been, the floor being splintered, and the side-walls missing in places. This was an old car, and during its years of service, had accumulated dirt and muck on the walls that consisted of almost everything that had ever been shipped in the car.

Still another test was made in cleaning a car in which shipments of fresh hides had been made. The walls and floor of this car were not heavily covered with refuse, but the odor remaining from hides was offensive. The walls and floor of this car were in good condition. After much experimental work a method was worked out which satisfactorily cleaned these cars.

Method of cleaning the cars

An empty drum for the storage of the cleaning solution, which is fed to the steam gun through a 3/16-in. welding hose, is placed on the top of car or any other suitable elevation. A valve connection is installed about 2 in. from the bottom of the drum, for controlling the flow of cleaning solution, which is fed by gravity.

A standard metal cleaner, at a strength of one-half pound per gallon, is used hot, being heated by turning hot steam into the drum through the steam hose. The procedure is as follows:

1—All loose refuse is removed by scraping and sweeping.

2—The car is thoroughly hosed out with cold water, and if the grain strip is poor it should be removed.

3—The cleaning solution is applied with a steam gun, over a period of from three to five hours, depending on the condition of the car, following every crack and crevice possible. This will require approximately 30 to 50 gallons of solution. Care should be taken to hold the gun over the crevice or opening a sufficient length of time to remove all refuse and saturate the wood.

4—The car should be thoroughly hosed out with cold water.

5—Chlorinated lime solution in the proportion of six ounces to the gallon should be made up in a 50-gal. barrel or drum. This should be thoroughly agitated and allowed to clear, containing no suspension of lime. The method of applying the chlorinated lime is the same as for applying the cleaning solution, care being taken to follow every crevice or opening. The under structure and flooring of the car should also be hosed off and sprayed with chlorinated lime solution. This solution liberates chlorine gas, and is very effective in clearing up bad odors. Ten to 20 gallons should be applied over a period of one to two hours, depending on the condition of the car. After the application of chorinated lime solution, the car should not be hosed down as this will destroy the effectiveness of the treatment.

6—The car should be allowed to dry out and if a slight odor still persists, 1½ lb. of chlorinated lime should be sprinkled on the floor of the car and brushed into the cracks or crevices allowing it to remain several hours before being swept aut.

The maximum cost of cleaning the dirtiest car of the four mentioned was as follows:

Labor, 10 hrs. at 40 cents per hr.	$4.00
Cleaning solution, 25 lb. at 13⅜ cents	3.34
Chlorinated lime, 9 lb. at 10⅔ cents	.96
Total	$8.30

Method of inspection

Three days after the cleaning was completed, the four cars were inspected. Three of the cars were passed as being suitable for any shipment, while the fourth car, which was used for fertilizer, still retained a trace of fertilizer odor. This car was passed as suitable for grain shipment. It was washed out again with the cleaning solution applied with the steam gun.

If there is the least trace of odor in a car it is impossible to ship such products as butter, flour, grain, etc. To check up the effect of the odor on such shipments, one pound of butter and half of a 25-lb. bag of flour were placed in the car that retained a slight trace of odor. The wrapper was removed from the butter and the bag of flour was left open. As a control a pound of butter from the same lot and a half of the bag of flour were kept in the storekeeper's office under a glass cover. After an exposure of 56 hr. in the car with the doors closed, there was no contamination of either the flour or the butter.

Interchange rules Nos. 30, 60 and 101

The Arbitration Committee has issued the following interpretations of Rules 30 and 60 to eliminate taking of joint evidence on trivial deviations in stencil markings, which are retroactive to cover unsettled cases under the rules and will be included in the first regular supplement to the current Rules of Interchange:

Rule 30. Q.—It is common practice to stencil new light weight marks a few inches directly above or below the line of previous marks to avoid delay in restenciling a car on account of wet paint over old marks.

It is also the practice to substitute 3-in. stenciling for 4-in. stenciling where the latter is the standard for the car, as well as 4-in. where 3-in. stenciling is standard. Do these deviations constitute wrong repairs?

A.—The new lightweight markings as to location and size should conform to the standard of the car. However, the conditions above described are not such as to justify the claim of wrong repairs.

Rule 60. Q.—Some roads are using 1¼-in. stencils, others 1½-in. for air brake marking, while the rule specifies 1-in. height. Should such marking be accepted as meeting requirements?

A.—The question of increasing the size of air brake stenciling is under consideration. It is suggested that a minimum of 1-in. and a maximum of 1½-in. be accepted as meeting present requirements.

Rule 101. Effective January 1, 1926, upon recommendation from the Committee on Brakes and Brake Equipment, the Arbitration Committee has modified Item 22A of this rule to read as follows:

Cylinder piston packing, Wabco, Flextite, Kendall or J. M. Type........

Attention is also directed to the following error in printing the 1925 Code of the Rules of Interchange, effective January 1, 1926:

Page 134, Rule 101, Item 194A, Note following—Service metal limit quoted in this note should read 35/16-in. instead of 3 5/16-in.

Flexible rivet bucker

By Joseph C. Coyle

WHEN repairing and rebuilding cars it is often necessary to drive rivets in positions where it is next to impossible to get the ordinary rivet bucker. The one shown in the illustration was originated for just such

A flexible rivet bucker which may be used in close places

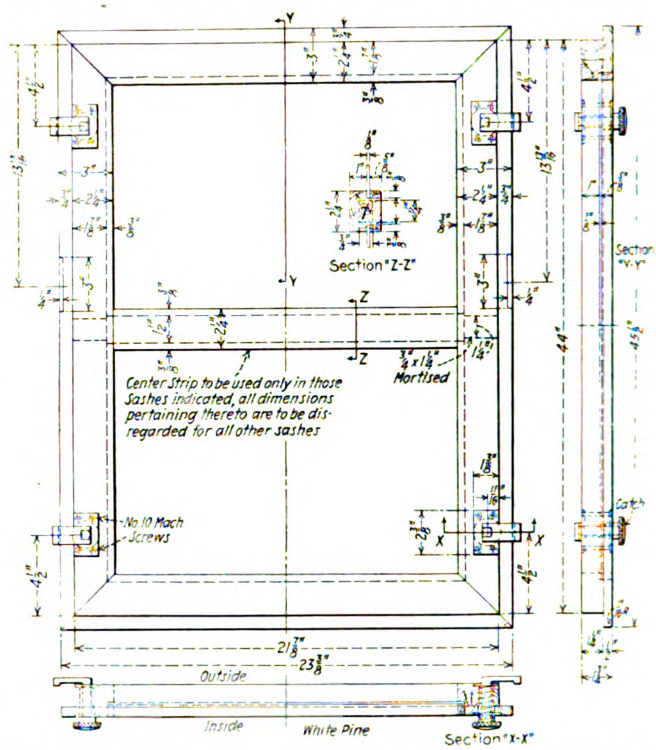
emergencies at the Denver shops of the Denver & Rio Grande Western. By the use of various amounts of blocking it may be used successfully in almost any position.

Two sections of 1½-in. round steel, 8 in. long are cut down about 4 in. from one end, with the acetylene torch. One of these sections is pointed at the opposite end to serve as a fulcrum for the bucker. A 4-in. section of 1½-in. by ¾-in. steel bar is loosely riveted to the center of the fulcrum and the back end of the bucker-bar. A second piece of the same size, 30 in. long is riveted to the end of fulcrum and the middle of bucker-bar, to act as a lever in the workman's hand. Owing to its flexibility this bucker may be inserted in very close places.

Emergency sash for passenger car windows

By E. A. Miller

WHEN the glass is broken in the door or window of a passenger car, it is generally left out until the train arrives at the end of its run, and when such accidents occur, it usually causes considerable inconvenience to the patrons of the railroad, especially in cold weather. An emergency sash, the detailed construction of which is



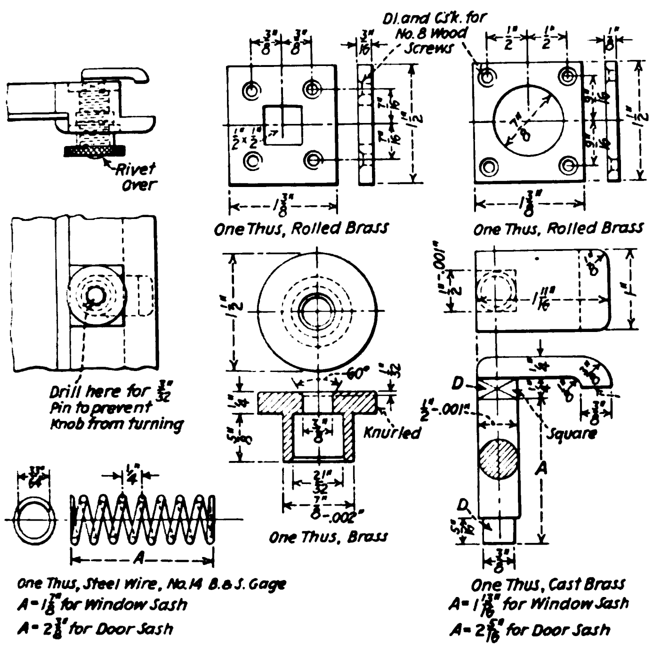
Drawing of the emergency sash for passenger car doors or windows

shown in the drawing, has been designed and used for a considerable time by at least one road to meet just such emergencies. It can be made in various sizes to suit different sizes of doors or windows which are not the same on all classes of passenger equipment.

When a window is broken, the pieces of broken glass are removed and the emergency sash inserted in the frame of the permanent window from the inside of the car. The emergency window is made with a flange which fits up against the sash of the car window. It is held in place by means of four clamps, the detailed construction of which is shown in one of the drawings. The clamp is held by a coil spring. It has a square section *D* on the shaft and a knurled handle. A plate with the square hole is screwed on the outside of the emergency sash and the plate with the round hole on the inside. In applying the emergency sash the handle of the catch is pushed in until the square portion *D* of the clamp clears the square hole of the outside plate. The clamp is then turned until the arm clears the opening in the permanent

sash. When the emergency sash is in position, the clamp is again turned until *D* fits in the outside plate. The compression of the spring holds the emergency sash in place.

Emergency windows, such as that shown in drawing, are kept at frequent points along the line. In case the glass in a car window or door is broken, it is only necessary to wire ahead to the next stop to have an emergency window ready to place in the car. This arrangement tends to reduce the inconvenience and annoyance of the patrons



Detail drawing of the catch

of the railroad to a minimum and all that is necessary is that the car inspector, repairman, or whoever has charge of the windows, know the class of car in order to have the proper emergency sash ready when the train arrives. All sashes assigned to a given point are stenciled "return to ——" so that when the car reaches the terminal, a new glass is put in and the emergency sash is returned to its assigned location. If desired, an emergency sash can be carried in the toilet of each car.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Defect card must be secured by handling line

Chicago, Burlington & Quincy car No. 102,193 was delivered empty to the Union Pacific by the Atchison, Topeka & Santa Fe at McPherson, Kan., on December 30, 1922, carded for movement home for repairs from Cleburne, Tex. The cards on the car, however, did not indicate the defects for which the car was returned to the owner and the car was not routed home over the Union Pacific. McPherson, Kan., is a junction point between the Union Pacific and the Santa Fe, but owing to the limited number of cars interchanged at this point, neither company maintains car inspectors there. The Union Pacific moved the car from McPherson, Kan., to Salina on December 30, 1922, and from Salina to Denver, Col., where it was delivered to the owner on January 7, 1923. The Union Pacific submitted an original copy of its record of inspection of this car at Salina, Kan., which showed that the car had six damaged sills when received at that point. When the car was delivered to the owner by the Union Pacific, the chief joint inspector issued a defect card against the handling line for which the owner rendered a bill for $334.68. When the handling line received the defect card, the car foreman of the Union Pacific at Salina asked the agent of that road at McPherson to request a defect card protection from the Santa Fe. The Union Pacific contended that the damage was in existence when the car was received from the Santa Fe and that as the Union Pacific moved the car over its rails to the owner, it should be protected by the Santa Fe against all claims of the car owner made under the interchange rules. The Santa Fe contended that the inspection of the car at Cleburne, Tex., showed that two metal center sills were badly bent and that the car was in need of general overhauling but was safe and therefore, as it had no record to show other than two metal center sills bent while the car was in its possession, the defect card protection required under Rule 43 was not due the U. P.

In rendering its decision the Arbitration Committee stated that "the interchange rules do not recognize the interchange of defective cars on record. If there was a combination of defective sills as per Rule 43 when the car was interchanged from the A. T. & S. F. to the Union Pacific, the latter should have protected itself by requiring a defect card or a statement as provided in the above rule, if it is claimed the damage occurred in fair service, at time of interchange. Therefore, the contention of the Union Pacific is not sustained."—*Case No.* 1350, *Union Pacific vs. Atchison, Topeka & Santa Fe.*

Substitution of steel tired for wrought steel wheels

The Canadian Pacific on October 22, 1923, removed a pair of wrought steel wheels from B. & L. E. car No. 14144 because of worn flanges and applied a pair of steel tired wheels, charging for 1½ in. of service metal in each wheel and allowing 1 in. service metal credit for each of the wheels removed. The car owner asked for a correction of debit to the value of the scrap metal in the steel tired wheels which request the Canadian-Pacific refused. The question involved in this case is, what is the proper method for handling the debits and credits wheen steel tired wheels are substituted for wrought steel wheels in cars stencilled to protect wrought steel wheels? The Canadian Pacific in defending its position, agreed that it had made wrong repairs and also that when steel tired wheels are removed and scrapped that the scrap value only should be allowed the car owner, but could not agree with the car owner that the charge for the wheels applied should be confined to the scrap value for the reason that, in no instance of wrong repairs performed by railway companies, is this principle invoked and the whole spirit of the A.R.A. rules is contrary to such a principle, according to Rule 88 and its interpretations. The car owner stated that it did not consider steel tired wheels safe for service because of the danger of a tire breaking or becoming loose from heating caused by the prolonged application of brakes on long grades or by brakes sticking. As a consequence the use of such wheels was discontinued many years ago. The steel-tired wheels applied by the Canadian Pacific to the

car in question were accordingly scrapped when removed. As a result, the car owner had on its hands a pair of steel-tired wheels which it could not use on its own equipment and which, it considered, could not be applied to foreign cars unless they were stencilled for such wheels, none of which had ever come within its knowledge. As a result of this situation, the car owner claimed that it should not be made responsible for this loss as the Canadian Pacific was not forced into the situation through not having wrought steel wheels in stock. It was possible for the repairing line to turn and re-apply the wheels removed.

The Arbitration Committee rendered the following decision: "The charges and credits account of wrought-steel wheels are covered in one billing transaction, in accordance with Rule 98, as an exception to the general rules covering settlement for other wrong repairs. A car owner should not be penalized for the improper substitution of steel-tired wheels by other roads. In view of the circumstances in this case, the steel-tired wheels should be billed against the car owner at scrap price." *Case No.* 1352, *Canadian Pacific vs. Bessemer & Lake Erie.*

Time limit for securing joint evidence

On August 12, 1923, Macon, Dublin & Savannah flat car No. 105 was received home from the Central of Georgia and was placed in the shop December 8, 1923, for general repairs. The following wrong repairs were discovered:

2 Center sill spices, 5 ft. by 8 ft. by 10 ft.	B
2 Draft timbers, 5 ft. by 8 ft. by 5 ft.	B
1 Carrier iron 1 in. by 3 in. by 24 in.	B
1 End sill 8 ft. by 8 ft. by 9 ft.	B
1 Dead block framed wrong without a groove for the striking plate	B
1 Striking plate, 1 in. by 8 in. by 28 in.	B
2 Center sills, 5 ft. by 8¼ ft. by 10 ft.	B
2 Draft timbers, 5 ft. by 9 ft. by 5 ft. 4 in.	B
1 Carrier iron 1 in. by 4 in. by 26 in.	B
1 End sill, 8 ft. by 8 ft. 3 in. by 9 ft.	B
1 Dead block framed for striking plate grooved	B
1 Striking plate, 1 in. by 4 in. by 28 in.	B

Joint evidence was secured by a representative of the car owner and the chief car inspector of the Central of Georgia. The joint evidence card together with the Ft. Worth & Denver City billing repair cards which showed that these wrong repairs were made by the F. W. & D. C., were mailed to the last mentioned road with a request to furnish an A.R.A. defect card to cover the wrong repairs made by that company. The F. W. & D. C. returned the joint evidence card and its billing repair cards, referring to Rule 12, paragraph 5, which states that joint evidence must be made within 90 days from first receiving the car home, and requested the M. D. & S. to withdraw its claims for a defect card. The car owner admitted that it had violated Rule 12 by not securing the joint evidence in the required 90 days and gave as a reason that owing to heavy business during the summer and fall months of 1923, the car was placed on the storage track to await its turn in the shop. The car owner stated further that it was not customary for car inspectors on interchange tracks to know the standard sizes of sills and such parts of cars and therefore, the wrong repairs were not discovered until the car reached the shop. Furthermore, the F. W. & D. C. violated Rule 87 by not attaching its defect card to cover the wrong repairs made, also violated Rule 113 by not using the material standard to the car, and it did not comply with Rule 16.

In rendering its decision, the Arbitration Committee stated that "The Macon, Dublin & Savannah failed to obtain the joint evidence within 90 days after first receipt of the car home, as per Rule 12, fifth paragraph. Therefore, the contention of the Ft. Worth & Denver City is sustained." *Case No.* 1351, *Macon, Dublin & Savannah vs. Fort Worth & Denver City.*

Another case under Rule 32

Chicago, Milwaukee & St. Paul loaded wooden box car No. 63200, while in switching service on the Chicago & Alton on June 24, 1923, broke in two and buckled out of line. The car was not derailed, cornered, or side-swiped, nor were any of the other cars handled at that time. The handling line refused to assume the responsibility for the defects under Rule 32 and instead reported the car to the owner under Rule 120. The owner claimed that under ordinary switching conditions the car could not have sustained the damages listed on the inspection certificate and, therefore, refused to accept responsibility. The handling line stated that the car while being shifted developed defects caused by its advanced age and general dilapidated condition which rendered it unfit for further movement and that the contents were transferred to another car. The handling line stated further that the conductor in charge of switching noticed the apparent weak and worn condition of the car and took precaution in handling not to damage it further. Furthermore the car was dropped in on the proper classification track at a speed of one mile an hour without rider protection which the handling line stated was not required in the Glenn yard which is a flat yard. The car owner contended that the car did not have the benefit of rider protection.

In rendering its decision the Arbitration Committee stated that, "The car was handled without rider protection and therefore, the handling line is responsible according to Rule 32, Section D, Item 4."—*Case No.* 1355, *Chicago & Alton vs. Chicago, Milwaukee & St. Paul.*

New wheels applied on authority of defect card

On November 19, 1923, when the Charleston & Western Carolina delivered Interstate car No. 5163 to its connection at Spartanburg, S. C., with two pairs of slid flat, cast-iron wheels a defect card was issued and attached to the car to cover 2½-in. defects. The car owner removed the two pairs of slid flat wheels and applied new cast iron wheels and rendered a bill against the Charleston & Western Carolina for the difference in value of scrap cast iron wheels and new cast iron wheels, brass and the labor charge applicable for making the repairs. The C. & W. C. claimed that the charge should have been confined to the difference in price between scrap and second-hand wheels, as the application of new cast iron wheels was a betterment for which the car owner was responsible. The handling line further contended that its exception was in accordance with Rules 98 and 101 and the charge for wheels should be as per Item 192-B, Rule 101. $14.56 instead of $47.12. The owner contended that the A. R. A. Rules in effect at the time the defect card was issued and at the time the wheels were applied, permitted the charge as made and if the C. & W. C. had wanted to confine the cost of making repairs to the difference in the price of scrap and second-hand wheels, it should have made the repairs and taken advantage of the rules which permit the replacing of slid flat wheels with serviceable second-hand wheels. It further contended that the claim of the C. & W. C. was inconsistent in so far as it referred to cast iron wheels as a betterment, as the wheel and axle statement showed that the wheels removed were cast August 15, 1923, and the wheels applied were cast September 6, 1923.

The Arbitration Committee rendered the following decision: "The owner's contention is sustained. The date of issuance of defect card governs the responsibility and 1922 Rules of Interchange are applicable. Owners are justified in charging for new wheels applied due to wheels removed on account of delivering line defects." *Case No.* 1354, *C. & W. C. vs. The Interstate Railroad.*

Preventing grinding wheel accidents

THE following recommendations are from the Safety Code approved by the American Engineering Standards Committee. They refer to precautions that should be taken to prevent accidents in the operation of grinding equipment.

Grinding machine requirements—Grinding machines should be sufficiently heavy and rigid to prevent vibration, and should be securely mounted on substantial floors, benches, foundations, or other structures.

Direction of spindle thread—The ends of spindles shall be so threaded that the nuts on both ends will tend to tighten as the spindles revolve. Care should be taken in setting up machines to see that the spindles are arranged to revolve in the proper direction, or else the nuts on the ends will loosen. To remove the nuts, they should both be turned in the direction in which the spindle revolves when the wheel is in operation.

Length of spindle thread—The length of the spindle and the distance that the thread extends from the end shall be such as to allow the entire length of the nut to bear on the thread so as to exert its full pressure on all thicknesses of wheels which may be used.

Spindle fit—Grinding wheels should fit freely on the spindles; they should not be forced on, nor should they be too loose.

Protection hoods—Hoods should be used on every operation where the nature of the work will permit, and should always be used with wheels that are not provided with protection flanges, chucks or bands.

Replacing hood—After mounting a new wheel, care should be taken to see that the hood is properly replaced.

Work-rest adjustment—The work-rest should be kept adjusted close to the wheel, with a maximum distance of ⅛-in., to prevent the work from being caught between the wheel and rest, and should be securely clamped after each adjustment.

Cup, cylinder and ring wheels—Cups, cylinders and sectional ring wheels should be either protected with hoods, enclosed in protection chucks, or surrounded with protection bands. Not more than one-quarter of the height of such grinding wheels shall protrude beyond the provided protection. Where the thickness of the rim of such wheels is less than 2 in., the maximum distance that the wheel may protrude beyond the provided protection shall not exceed 1 in. If the thickness of the rim is 2 in. or more, the wheel may protrude 2 in. beyond the protection, but shall not exceed this amount.

Inspection of wheels—Immediately upon receipt, all wheels should be closely inspected to make sure that they have not been injured in transit or otherwise. As an added precaution, wheels should be tapped gently with a light implement, such as the handle of a screwdriver. If they sound cracked, they should not be used. Wheels must be dry and free from sawdust when being tested. Before being mounted, all wheels should again be closely inspected to make sure that they have not been injured in transit, storage or otherwise.

Inspection after breakage—Whenever a wheel breaks, a careful inspection shall be made to make sure that the hood has not been damaged, nor the flanges bent or sprung out of true or out of balance. The spindle and nuts shall also be carefully inspected.

Surface condition—All surfaces of wheels, washers and flanges in contact with each other should be free from foreign material.

Bushing—The soft metal bushing shall not extend beyond the sides of the wheel.

Washers or blotters—Washers or flange facings of compressible material shall be fitted between the wheel and its flanges. If blotting paper is used, it should not be thicker than 0.25 in. If rubber or leather is used, it should not be thicker than ⅛ in. If flanges with babbitt or lead facing are used, the thickness of the babbitt or lead should not exceed ⅛ in. The diameter of the washers should not be smaller than the diameter of the flanges of the grinding wheels.

Tightening of nut—When tightening spindle end nuts, care should be taken to tighten them only enough to hold the wheel firmly; otherwise, the clamping strain is likely to damage the wheel or associated parts.

Responsibility—Competent men should be assigned to the mounting, care and inspection of grinding wheels and machines.

Starting new wheels—All new wheels shall be run at full operating speed for at least one minute before applying the work, during which time the operator shall stand at one side.

Appying work—Work should not be forced against a cold wheel, but applied gradually so as to give the wheel an opportunity to warm and thereby minimize the chance of breakage. This applies to starting work in the morning in cold rooms and to new wheels which have been stored in a cold place.

Dresser guards—Wheel dressers, except the diamond type, shall be equipped with guards over the tops of the cutters to protect the operator from flying pieces of broken cutters or wheel particles.

Grinding room—The space about the machine should

be kept light, dry and as free as possible from obstructions.

Lubrication—Care should be exercised so that the spindle will not become sufficiently heated to damage the wheel.

Flanges—All wheels except those that are mounted in chucks shall always be run with flanges.

Recess in flanges—Each flange, whether straight or tapered, shall be recessed at the center at least 1/16 in. on the side next to the wheel.

Flange fit—The inner flange, shall be keyed, screwed, shrunk, or pressed on the spindle, and the bearing surface shall run true at right angles with the spindle. The bore in the outer flange should be not more than .002 in. larger than the spindle.

Test for balance—Wheels should occasionally be tested for balance and rebalanced if necessary. Wheels worn out of round should be trued by a competent man. Wheels out of balance through wear, which cannot be balanced by truing or dressing, should be removed from the machine.

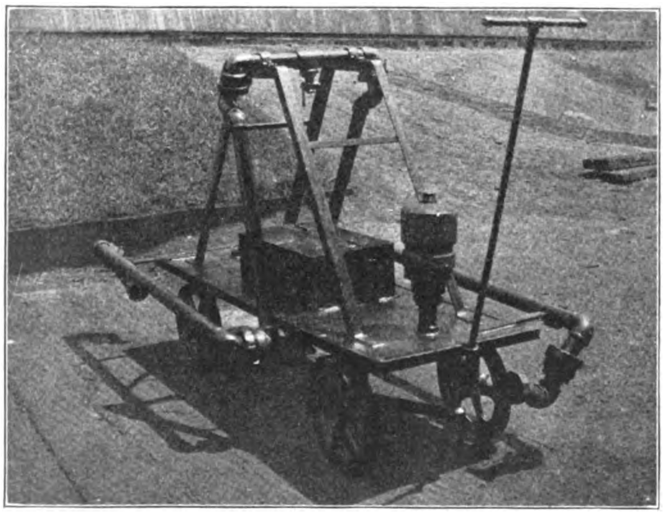
Truing—Truing is best accomplished by the use of a diamond rather than with a wheel dresser, the function of which is dressing only. Truing is not necessarily a sharpening operation, but is what its name implies. Dressing rarely trues a wheel.

Wet grinding wheels—Wheels used in wet grinding should not be allowed to stand partly immersed in the water. The water-soaked portion may throw the wheel dangerously out of balance. All wet tool grinders that are not so designed as to provide a constant supply of fresh water should be thoroughly drained at the end of each day's work, and a fresh supply provided just before starting.

Side grinding—Grinding on the flat sides of straight wheels is often hazardous, and should not be allowed on operations where the sides of the wheel are appreciably worn thereby or where any considerable or sudden pressure is brought to bear against the sides.

Boiler blow-off truck

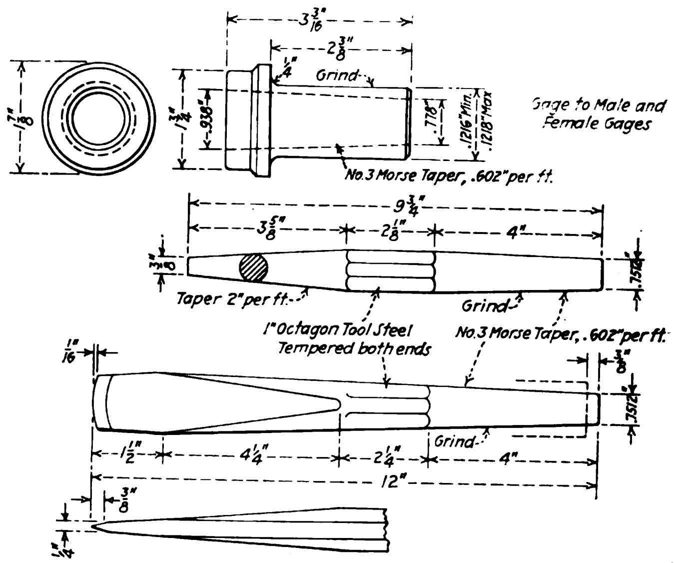
Anyone who has ever had anything to do with work around an enginehouse knows what a disagreeable job washing boilers may prove to be at times. Any device which will render this work less unpleasant or save time and labor is of more than usual interest. The accompanying illustration shows the general arrangement of a truck used at the Glennwood, Pa., engine terminal of the Baltimore & Ohio which saves much work and eliminates the handling of hose. The outfit is simple to construct, consisting principally of a four-wheeled platform truck with a strap iron frame-work, supporting several sections of suitable size pipe connected by flexible ball-joints. The several sections are arranged in such a manner that they may conveniently be used to make the connection from the boiler blow-off cock to the blow-off line of a boiler washing and filling system. On the platform of the truck is a tool box containing all the necessary tools for the job, and a muffler to be used when blowing off steam from the boiler.



Truck equipped with portable blow-off connections

Taper shank for air hammer tools

The taper shank for air hammer tools is being accepted in many shops as standard equipment and is also manufactured by a number of pneumatic tool companies. It is said to be a considerable improvement over the round shank which tends to break due to the repeated stresses set up by the air hammer plunger. The taper shank is driven from the taper seat or guiding shell which permits greater freedom of action of the tool in respect to alinement with the air hammer body. The round shank tool does not allow for such action but is held in rigid alinement.



Taper shank tools for air hammers

Another point claimed in favor of the use of a taper shank for air hammer tools is that it is not necessary to finish the shank which eliminates machine work. The shank can be formed in a die in the blacksmith shop to the required taper. After the taper shank has been drawn but, it is ground off so that it will extend through the guiding shell the required length of 3/8 in.

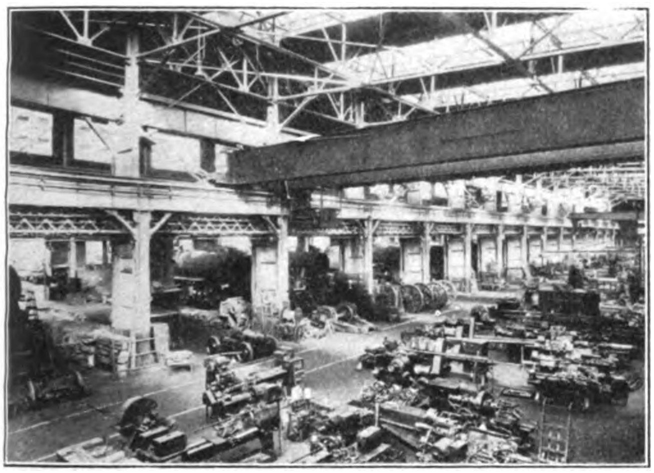
A New Record for heavy locomotive repairs for the lines west of Pittsburgh was attained recently at the Columbus, Ohio, shops of the Pennsylvania Railroad when 59 class repairs and 20 heavy running repairs were turned out during the month of March. The work, accomplished with the help of skilled workers from other points in the western region, under the direction of T. W. Lowe, general foreman, locomotive department, included three Class 1 repairs; 13 Class 2 repairs; 33 Class 3 repairs; 10 Class 4 repairs, and repairs to 77 tenders.

Repairing locomotives at Pennsylvania Railroad Juniata shop*

Utilization of semi-finished parts and micrometers, dimension forms—Other machine shop methods

Part II

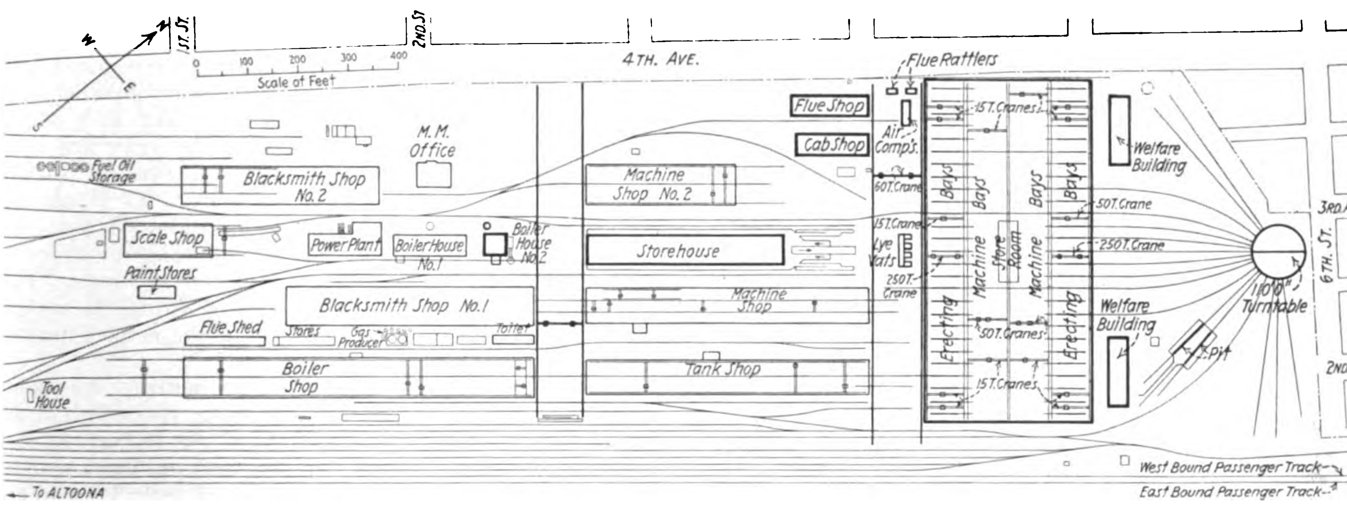
IN order properly to understand many of the machine operations in the two machine bays and the plan followed by the inspectors when deciding on the repairs required and the system of marking on the special



The machines in the foreground are used in the brass and bolt gang—To the left is a general view of erecting shop No. 2

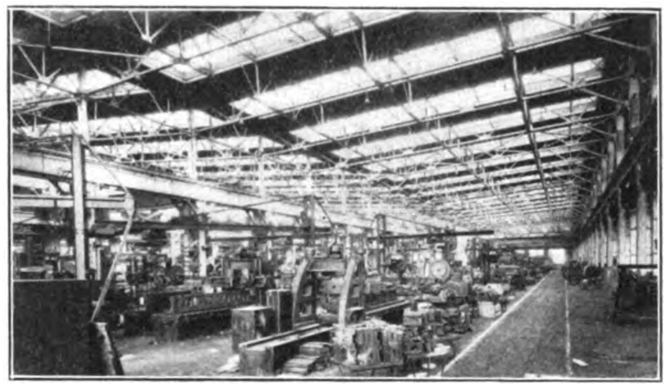
dimension blanks the sizes to which the new parts should be machined, a general knowledge of the Pennsylvania Locomotive Maintenance Instructions is necessary.

These instructions have been issued for the guidance



General plan of the Juniata shops—The new facilities are shown in heavy lines

of the shops when manufacturing parts for new or repaired locomotives, when fitting new parts to the old parts, and in determining allowable limits of wear before repairs or replacements are considered necessary. Practically all the measurements mentioned on these instructions are in thousandths of an inch, which makes it comparatively easy to take all measurements with micrometer



General view of the west machine bay showing the machines for repairing driving boxes in the foreground—Note the platforms loaded with material brought from the cleaning vats by electric trucks

calipers and record them readily on dimension blanks. Owing to the fact that the limits of wear on the various wearing surfaces, as well as the tolerances permitted on the part of the workmen when fitting new parts, are specified by the maintenance instructions, the effect of variations in individual judgment of the inspectors or workmen is eliminated.

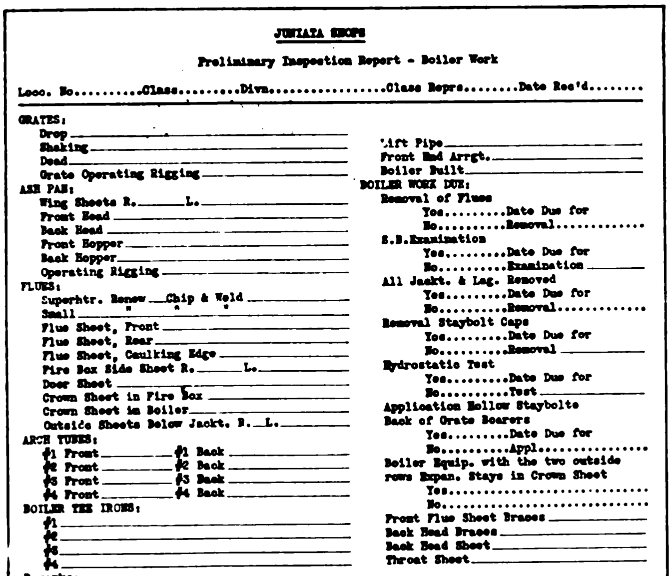
This may be illustrated by the case of a journal of a driving axle. The Locomotive Maintenance Instructions specify that when the journal of a driving axle is less

*The shop layout, machine tools and shop equipment, the scheduling system, material delivery and inspection methods were described in Part I.

than .032 in. out-of-round, has less than .032 in. taper and is not cut or in otherwise poor condition, it will be satisfactory to put the journal back into service without making repairs. When the out-of-round, or the taper exceeds these limits, the journal must be turned and refinished. The instructions also specify that after re-turning, the limit of out-of-round or taper shall not exceed .005 in.

When the axle is ready for inspection, the inspector measures the journal with micrometer calipers, first ascertaining the largest then the smallest diameter, the difference between the two readings determining whether or not the journal will go back into service without repairs, or whether it shall be sent to the journal lathe for re-turning. Assuming that the journal comes within the limits and is smooth, under which condition no turning is required, the size of the largest diameter is then marked on the dimension chart blank for frame, journal, hub and box sizes shown in the illustration. In the event of not meeting the maintenance requirements, the journal is marked for re-turning, after which it is again inspected and if the dimensions are according to requirements, the largest size is measured and marked on the dimension blank.

From the data given on these dimension blanks, the diameter to which the driving box brass is to be bored is determined; that is, the bore of the driving box brass should be .020 in. larger than the journal. However, a limit of .005 in., plus or minus, is allowed the workman when boring the brass. Therefore, he must bore between


JUNIATA SHOPS

Preliminary Inspection Report - Boiler Work

Loco. No..........Class.........Divn.................Class Repre........Date Rec'd........

GRATES:
Drop
Shaking
Dead
Grate Operating Rigging
ASH PAN:
Wing Sheets R. ______ L.
Front Head
Back Head
Front Hopper
Back Hopper
Operating Rigging
FLUES:
Superhtr. Renew ___ Chip & Weld
Small " " "
Flue Sheet, Front
Flue Sheet, Rear
Flue Sheet, Caulking Edge
Fire Box Side Sheet R. ______ L.
Door Sheet
Crown Sheet in Fire Box
Crown Sheet in Boiler
Outside Sheets Below Jackt. R. __ L.
ARCH TUBES:
#1 Front ______ #1 Back
#2 Front ______ #2 Back
#3 Front ______ #3 Back
#4 Front ______ #4 Back
BOILER TEE IRONS:
#1
#2
#3
#4

Lift Pipe
Front End Arrgt.
Boiler Built
BOILER WORK DUE:
Removal of Flues
Yes.........Date Due for
No..........Removal.............
S.B.Examination
Yes.........Date Due for
No..........Examination
All Jackt. & Lag. Removed
Yes.........Date Due for
No..........Removal.............
Removal Staybolt Caps
Yes.........Date Due for
No..........Removal
Hydrostatic Test
Yes.........Date Due for
No..........Test
Application Hollow Staybolts
Back of Grate Bearers
Yes.........Date Due for
No..........Appl................
Boiler Equip. with the two outside rows Expan. Stays in Crown Sheet
Yes.............................
No..............................
Front Flue Sheet Braces
Back Head Braces
Back Head Sheet
Throat Sheet

Remarks:

Date Inspected ______ Inspector ______

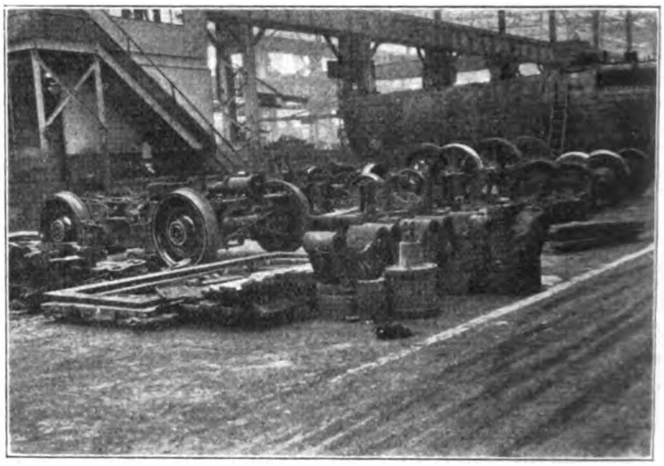
When the boiler inspector makes an examination of a locomotive coming into the shop he fills out this report

.015 and .025 in. larger than the journal to meet the requirements.

While the driving axle has been cited as a specific case, similar instructions covering practically all of the important locomotive parts are available. These instructions are posted about the shops and are frequently referred to by the inspectors and the workmen. In the event of disputes, the micrometer measurements and the instructions will show who is at fault.

Repairing parts in the machine bay

The practice of standardizing the repairs of locomotive parts makes it possible for many of the parts to lose their identity when removed by the stripping gang. Thus, the driving boxes, main and side rods if the brasses must be renewed, pistons, crossheads, valve and link motion parts, foundation brake and spring rigging, ash pans and engine and trailer trucks seldom are put back on the same locomotives from which they were removed. These parts are repaired and brought back to standard dimensions, except where variable conditions are met due to fits to other parts, after which they are considered as stock material. Say, for instance, a set of Ils driving box sizes are needed for the erecting shop to lay out shoes. These stock boxes have been repaired and await only the journal and hub sizes for final boring and facing of the brasses and hub liners. Ten boxes are selected, the engine number and



Engine and trailer trucks are repaired along the west side of the office building

location are stenciled on them and the sizes furnished the erecting shop on a form. After the journal and hub sizes are determined the boxes can then be bored and faced to fit. This practice speeds up the repair operations and permits a considerable part of the machine shop repair work to be done on a small scale production basis. Parts like brake rigging lose their identity, are made standard and sent to the locomotive in complete sets.

After removing the main rods, they are cleaned and forwarded to the rod gang, placed on trestles, the brasses removed and the rods examined for possible defects. The openings in the front and rear jaws are measured with micrometers. If a jaw opening varies from parallel more than the maximum allowed, the rod is sent to a slotter for truing. Also if the side faces of the jaws are worn out of parallel, they are ground on a vertical surface grinder while held on a magnetic chuck. As a rule, the blocks, wedges and, at times, the front end brasses are placed in the rods at the time of grinding in order to finish these parts flush with the sides of the rods. This practice eliminates much of the work of fitting the wedges and brasses and also gives the sides of the rods a finished bearing surface.

After the ends are found to be within the limits specified by the maintenance instructions, the width of the jaw opening and also the thickness of the rod at the rear end are measured with micrometers and the sizes marked on a blank from which the front and rear brasses are milled to the required rod fits.

Machining rear main rod brasses

The scale on the phosphor bronze rod brass castings rapidly wears the cutting tools and this is expensive in the case of milling cutters. The back end main rod brasses are, therefore, rough machined on planers. 16

pairs at one set-up. This work is done in one of the production machine shops at Juniata or the Altoona machine shops. The two abutting surfaces are smoothly finished and the surfaces that bear on the rod are rough planed to allow about 3/16 in. on all surfaces for the final fitting in the rod. These semi-finished brasses are then placed in stock.

When a new pair of rod brasses is to be placed in a rod, the final finishing is done in the west machine shop bay of the new shop on a knee type plain milling machine. The semi-finished brasses are held in an eight-point indexing fixture shown in one of the illustrations. The two halves of the brass are butted together and clamped

A section of the valve and link motion repair gang

by the handle shown at the top of the fixture. The width between the flanges on one side of the brass is milled to the dimension called for on the rod dimension blank. During the milling operation this dimension is frequently checked with inside micrometers to insure that the distance will be the same as the rod width. The micrometer dial on the elevating screw of the machine is set to zero after the milling of the first lower flange has been completed and a memorandum is made of the reading at the completion of the first upper flange. These readings are used when milling the flanges on the other faces of the brass.

The rod bearing surface between the flanges is then milled, after which the fixture is indexed one half turn and the opposite flange and the rod bearing surface are milled. The table elevation for the flanges is governed by the previous dial settings. The width between the two rod bearing surfaces is carefully measured with outside micrometer calipers to insure that this distance will be the same as called for on the dimension blank. The fixture is then indexed one quarter turn, after which the front flanges and the bearing surface between them are milled. The same operation is repeated for the opposite end. The brasses are then stamped to designate the rod to which they belong and also with the workman's initials.

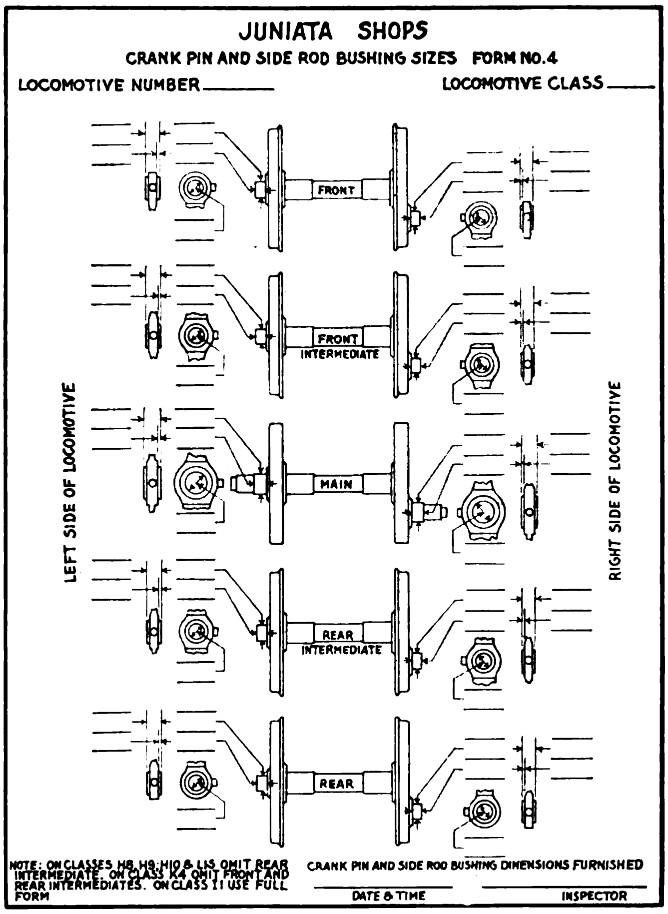
One of the novel features of this practice of fitting rod brasses is the fact that the man who mills and measures the brasses seldom sees the rod into which they are to be placed. Old brasses within certain limits are reclaimed by sweating liners on them and machining to fit in much the same way.

Correct fits require accuracy of measurement on the part of one man and accurate machine work on the part of another. It has been found that the men soon become proficient in these methods, so that they can make fits which require no filing other than to remove the burrs.

Machining front main rod brasses

The front main rod brasses are semi-finished in the manufacturing shops in the same manner as the rear brasses, with an allowance of about ⅛ in. for final finishing. The top and bottom surfaces of the brasses that fit the rod jaws are milled according to the dimensions called for on the dimension blanks. The general plan of milling is similar to that described in connection with rear brasses. The sides of the front brasses are at times ground on the surface grinder when truing the sides of the rods. Old front end brasses within certain limits are reclaimed the same as are the back end brasses.

After the milling of the brasses has been completed and such minor work as wedge repairs, re-reaming taper holes, etc., is finished the brasses, wedges and necessary parts are placed in the rods. They are then stored until the sizes for boring the brasses are available. Owing to the interchangeability of the rods on locomotives of the same class, it is not necessary to replace the rods on the same locomotive from which they were removed. A considerable number are thus always on hand in the shop ready for the final boring for the crank and crosshead pins. The



JUNIATA SHOPS

CRANK PIN AND SIDE ROD BUSHING SIZES FORM NO.4

LOCOMOTIVE NUMBER______ LOCOMOTIVE CLASS______

NOTE: ON CLASSES H8, H9, H10 & L1S OMIT REAR INTERMEDIATE. ON CLASS K4 OMIT FRONT AND REAR INTERMEDIATES. ON CLASS I1 USE FULL FORM

CRANK PIN AND SIDE ROD BUSHING DIMENSIONS FURNISHED

DATE & TIME INSPECTOR

This form is filled out by the driving box, rod and wheel inspector

locomotive number is stencilled on the rods after the pin fits have been bored.

Boring crank and crosshead pin sizes

The sizes for the boring of crank and crosshead pins are taken from the dimension blanks shown in one of the illustrations. When boring and facing the rear rod brasses, they are held in a special fixture on a 36-in. vertical side boring mill. The tightening of the fixture automatically centers the brass on the machine table. It

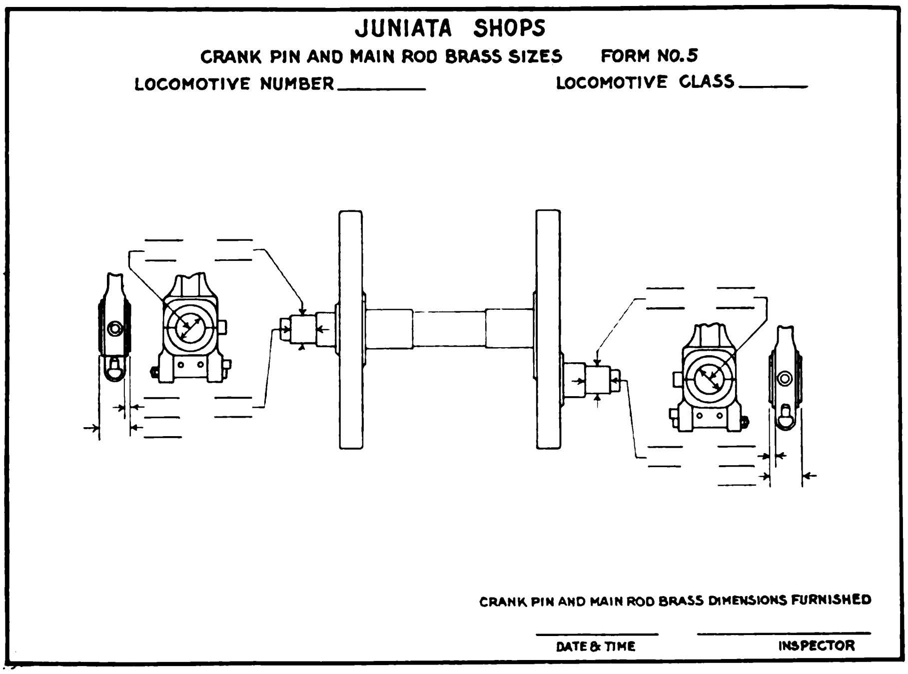
is then bored to micrometer sizes which are .010 in. larger than the crank pins as called for on the dimension blank. The top side is faced while in the fixture and, after a second chucking, the bottom side is faced so that the distance between the faces is the same as called for on the dimension blank.

Repairing driving boxes

After removing the driving boxes, they are cleaned and forwarded to the driving box section located in the west machine bay. The machines and work are arranged in the box gang so that the boxes always move forward without back traveling. The cellars are removed and the brass and babbitt side bearings are examined and, if not satisfactory, the brasses are removed in a 70-ton motor-driven hydraulic press.

The shoe and wedge faces are examined and, if found worn or if the two faces are not in proper alinement, the boxes are sent to the planer for refacing. The boxes are bolted in a double row against an upright center piece, the sides of which are parallel to the center line of the table of a 48-in. by 16-ft. planer, the lower shoe or wedge faces of the box resting on a parallel strip. The general practice is to load the planer with as many boxes as can be selected having approximately the same distances between shoe and wedge faces, in order to machine the greatest possible number at one time. After finishing one face, the boxes are reversed and the opposite surface refinished.

On the average about 150 driving boxes are always undergoing repairs in the box gang. Thus, it is possible to select boxes having approximately the same amount of wear below the standard dimensions. The odd sizes are held for later matching with boxes of similar sizes,



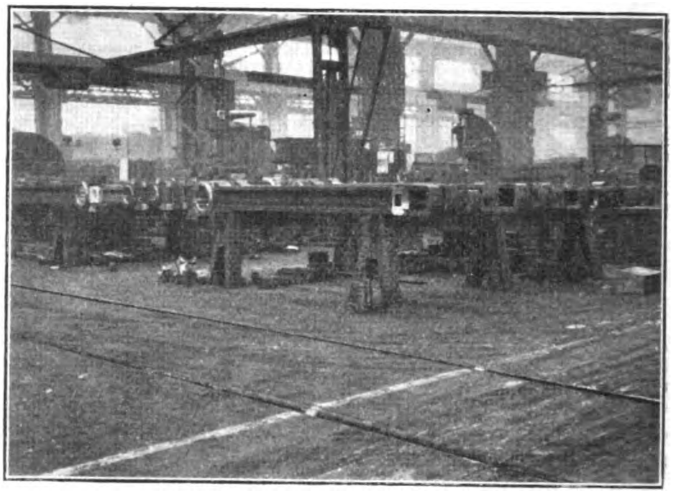
The machine operators determine the final crank pin and main rod brass sizes from this form

so that it is practically never necessary to operate the planer with less than a capacity load. This condition has been made possible by the fact that a driving box need not go back on the locomotive from which it was removed.

Turning the outside of driving box brasses

The size of the recess for the brass in the driving box is measured with micrometers and set down on a dimension blank. The size for turning the outside of the brass is taken from this data. The brasses are turned, two at a time on a 30-in. by 12-ft. lathe, shown in one of the illustrations, which is equipped with two tool posts on the carriage, one for each brass.

The two brasses are held on the arbor as shown. This



The driving rods are repaired in the north end of the machine bays

has one central fixed flange common to the two brasses and two movable flanges, each adjustable by a nut in order to accommodate varying lengths of brasses. The brasses are held between the flanges by cup-pointed set screws located in the flanges, the points of which bear against the ends of the brasses.

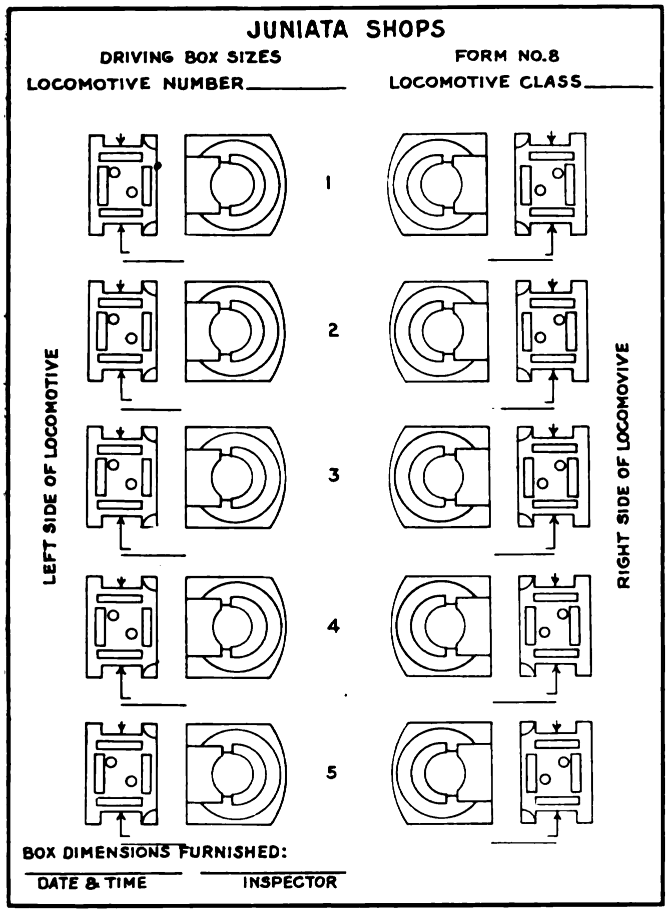
When loading the arbor, a block or filler piece is placed on the arbor, which also rests against the inside crown of the brass, locating it to the correct radius. The two brasses are rough turned and the tools are then set to the correct size and the finish cut taken. The advantages of the double arbor are the better running balance of the lathe and the saving of time.

The brasses are afterwards slotted for end size and then pressed into the driving boxes. The babbitt side bearings are then removed by placing the box in melted babbitt at the babbitt furnace, after which the new babbitt is applied. The box is then repaired at the cellar fit and a previously repaired cellar is then put in place. After these operations the boxes are stored awaiting the sizes for the final boring and facing. Owing to the large number of locomotives in the shop, the repair operation on the driving boxes up to this point is flexible. There is never any delay for want of driving boxes ready for boring and facing and the box sizes for laying off the shoes and wedges are available as soon as the locomotive is placed on the repair track so that the scheduling of this item is not of much moment. When box sizes are furnished the erecting shop, the boxes are stencilled with the locomotive number, wheel number and box location after which the box assumes identity.

Boring and facing driving boxes

The sizes for the boring of the driving boxes and the facing of the babbitt hub plates are set down on dimension blanks, as shown in one of the illustrations by the inspectors when inspecting the driving wheels. The blank is then given to the driving box gang foreman who picks out the set of boxes for that locomotive, having stencilled on them the locomotive number and journal location whose pedestal fit sizes he has furnished the erecting shop previously and the boxes are then bored and faced to conform to the journal chart.

The boxes are bored and faced on a special driving box boring mill, which is equipped with a special heavy two-jaw universal chuck amply strong to hold the box under the heaviest cut. The box is held on the two shoe and wedge faces by the chuck jaws which, when tightened,

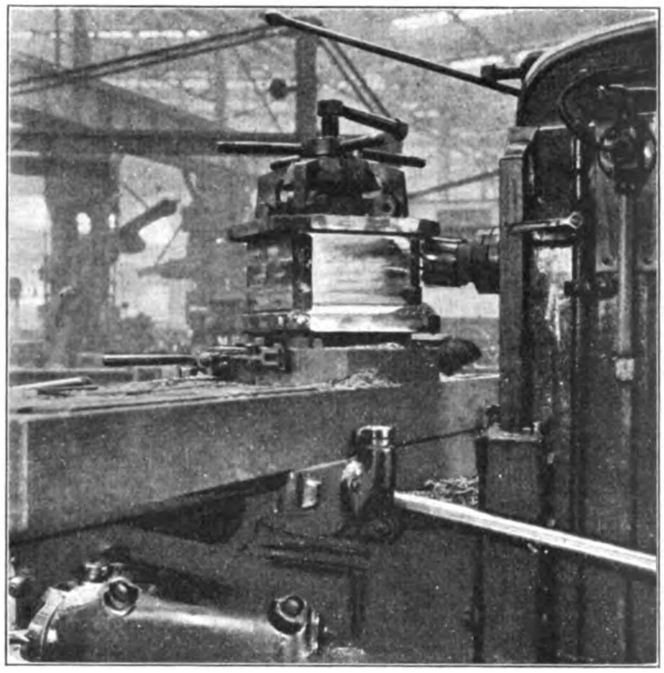


This form is filled in and given to the planer operator in the driving box gang

bring the vertical center line of the box into line with the turning center of the machine. The chuck with the box in place is adjustable in relation to the machine table in line with the vertical center line of the box.

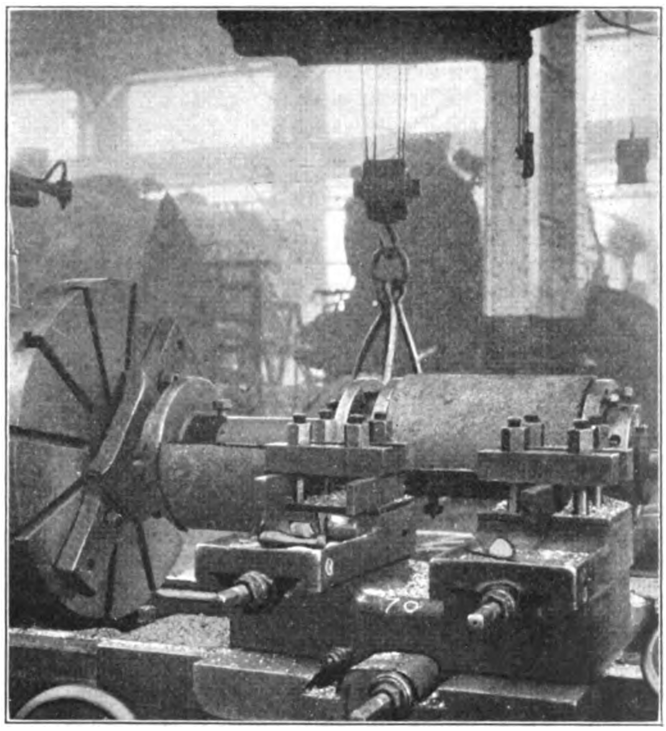
The roughing and finishing boring tools are held in a large adjustable boring bar similar in design to that used for car wheel boring. The hub liner is turned with a tool held in the side head. When starting the work, the driving box with the cellar in place is lifted with a jib crane into the mill and tightened in the chuck, which is adjusted by a single screw to bore the desired amount from the crown of the brass. The height of the side cutting tool is set from the lower surface of the upper flange of the box. The dimension for this setting is taken from the wheel dimension blank. The cutting tools in the boring bar are set for the roughing out by the micrometer dial on the boring bar.

The brass and the walls of the cellar are then rough bored and at the same time the box is faced to size. The boring bar is then raised and the chuck shifted to bore 1/32 in. higher in the crown in order that the cellar will



With the use of this jig the four faces and the corners of a main rod brass can be milled with one set-up

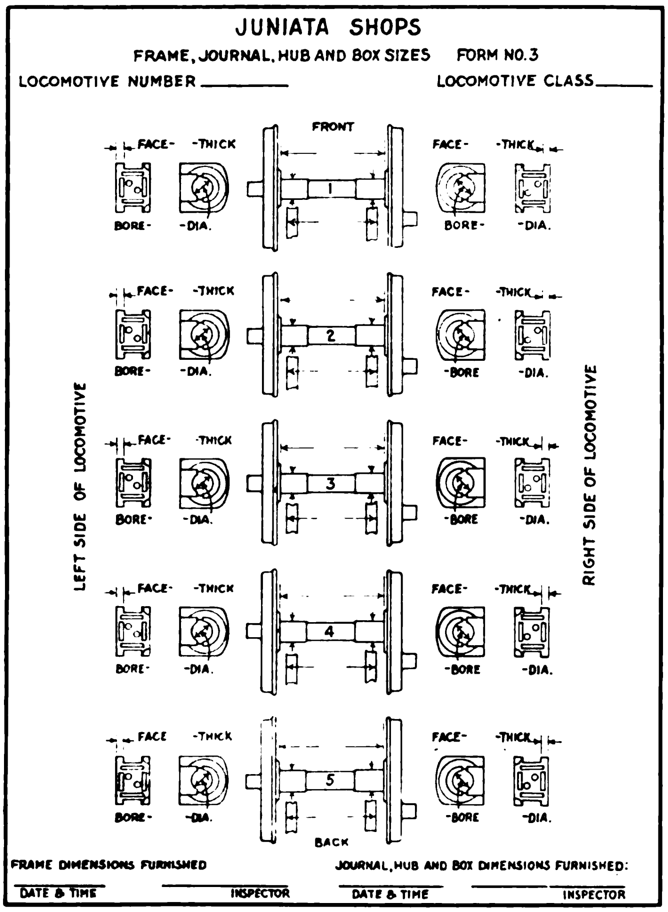
not come in contact with the journal. The finishing cut is then taken and at the same time the fillet is turned on the brass with the back side of the side head tool. The



Turning two driving box brasses in a lathe at one set-up

cellar is removed and after resetting the box and tool, an axle clearance cut of .02 in. is taken from the bottom part of the brass sides. After the completion of these operations, the diameter of the bore is checked with a special

three-pronged micrometer shown in one of the illustrations. The box is then removed. Attention is called to the fact that the only measurements made are after the completion of the machine operations, a condition made possible by the micrometer measurements. The advantage of the method is reflected in the time taken to complete the boring and facing of a driving box, which under every-day conditions is less than 25 min. from floor to floor. Owing to the close tolerances to which the work is done, the operation of spot facing to the journals is not necessary. After this operation, grease grooves are milled in the crown brass and the box and cellar assembled and



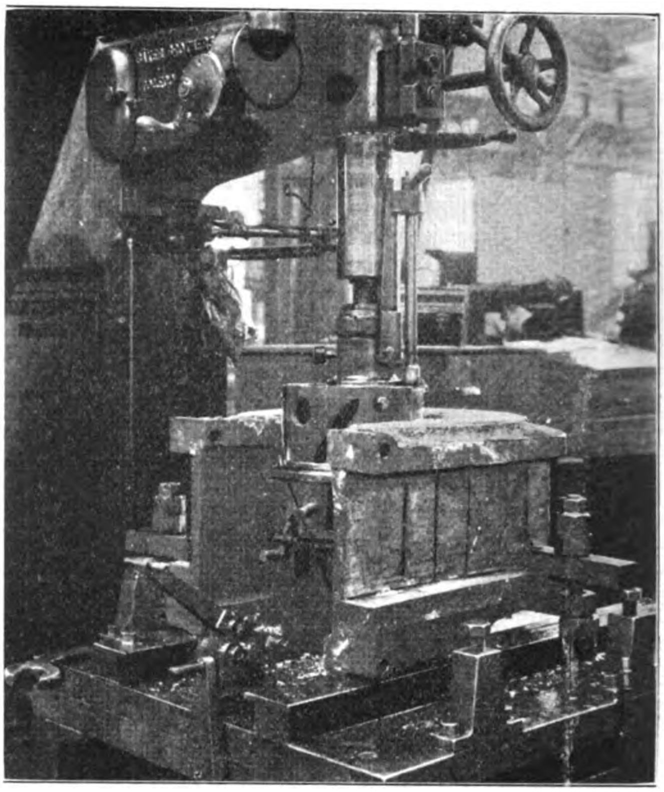
The dimensions set down in this form are used by the driving box gang

delivered by a jib crane to the wheel gang. The method of handling boxes is typical of the manner of sequence in which the different repair operations are performed on the locomotive parts.

The valve motion work is sent to the proper repair gang where all the parts are checked for size by means of micrometers and gages. Particular attention is given to the piston valves. They are dismantled and checked by limit gages and if found below the limit they are scrapped. The bull rings are fitted up with packing rings according to the size of the valve bushings, which are bored out twice in steps of 1/8 in. each before renewing, giving a maximum diameter 1/4 in. over size. The boring heads for this work are kept in the toolroom where the tools are ground and set to bore the proper diameter of piston valve bushings.

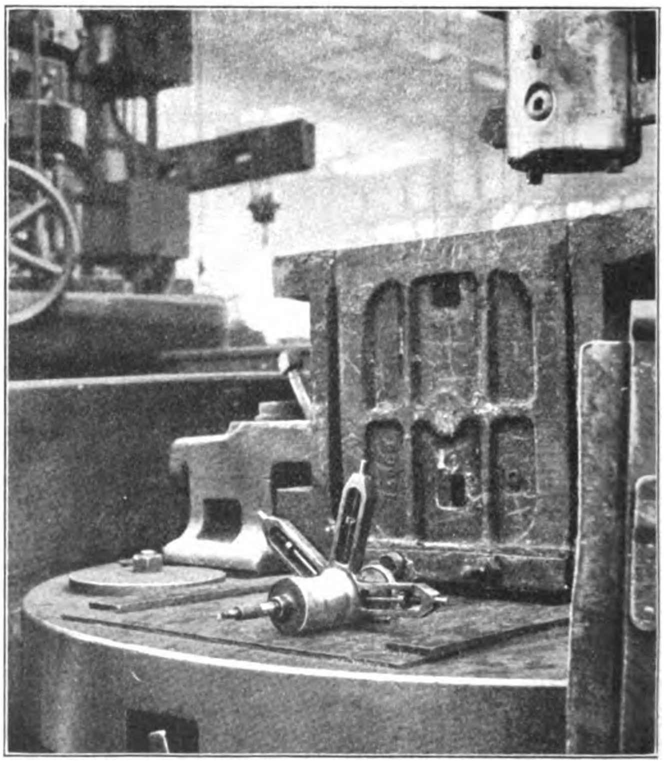
Conclusion

The arrangement of the shop layout, the selection and location of the machine tools and shop equipment and the methods of handling the work which were described in



Jig for milling the grease grooves in a driving box brass

this article were planned by the officers of the mechanical department under the direction of J. T. Wallis, chief of motive power. During the month of December, 1925, which contained 22 working days, 102 locomotives received classified repairs. In this number were two Class 1, 16 Class 2, 30 Class 3, 17 Class 4, 25 Class 5 and 13 heavy running repairs.



One of the boring mills for machining crown brasses—The three-pronged micrometer shown is used by the operator to determine the final bore in thousandths of an inch

View of the Hampton engine terminal, Delaware, Lackawanna & Western, Scranton, Pa.

D. L. & W. engine terminal at Hampton

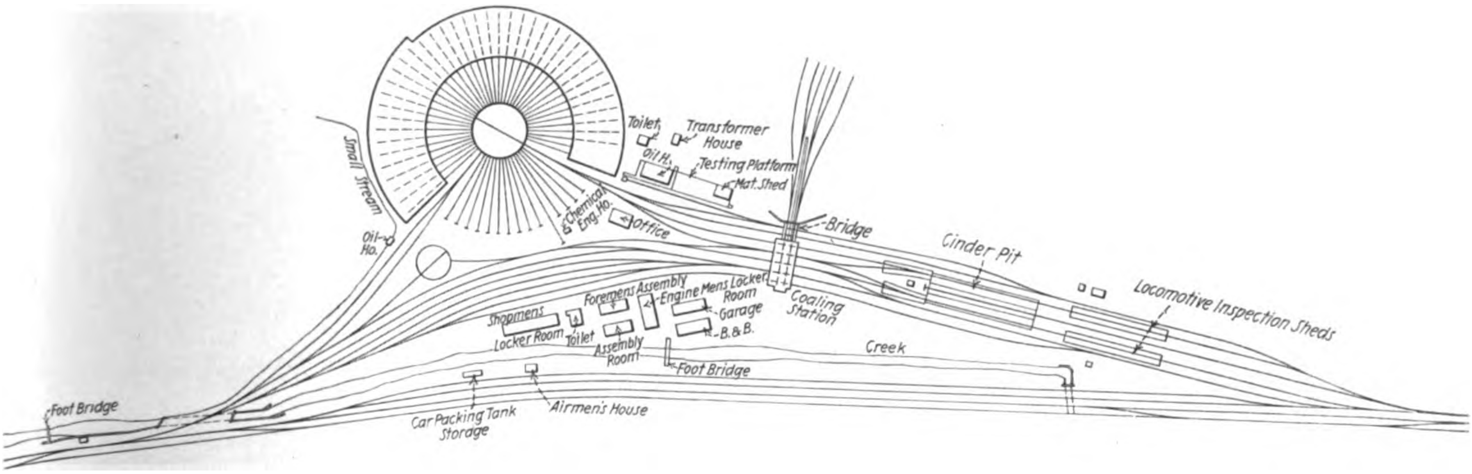
Is equipped with inspection sheds, ash pits, gravity coal chutes, and other mechanical features of improved design

By M. R. Feeley

Master mechanic, D. L. & W., Scranton, Pa.

IN order to accommodate the large amount of freight traffic handled from the Keyser Valley branch and adjacent territory, the Delaware, Lackawanna & Western constructed a 41-stall enginehouse at Hampton, located just outside of Scranton, Pa., which was placed in operation May, 1910. The larger part of this traffic consists of practically the entire output of anthracite coal from the Glen Alden Company's mines, as well as a number of smaller individual operators. The yards of the terminal which the Hampton enginehouse serves are approximately five miles in length, with 92.7 miles of yard tracks having a capacity of approximately 12,000 cars. To simplify operation, the yards are divided into east and westbound yards which are in turn subdivided into receiving, classification and caboose yards. A car repair yard of ten tracks is also included in the layout which has a capacity of 150 cars. Hump facilities are provided and are used mainly for classifying the coal, but they are also used for classifying westbound freight. All other car movements within the yard are made by flat switching.

In normal times the Hampton engine terminal is required to repair and turn from 60 to 70 locomotives in 24 hours and to turn as many as 85 locomotives in rush periods. Practically all of these locomotives, with the exception of a small number of switch engines, are of the Mikado type.



Layout drawing of the tracks and buildings of the Hampton engine terminal

Referring to the layout drawing, locomotives are brought by the engine crew to the locomotive inspection shed. They are routed from the inspection sheds past the water crane, the location of which is shown in one of the illustrations, over the cinder pits to the coaling station. From this point they can be diverted either to the enginehouse or to the O.K. track. Locomotives going into serv-

ice are taken out of the engine terminal at the opposite end from the locomotive inspection shed. Fig. 1 shows a Mikado type locomotive arriving at the inspection pit. When the engineman leaves the locomotive at the pit on completion of the trip, he immediately consults the inspection pit foreman as to any conditions that should receive attention. While this inspection is going on, the tool boy, who is shown ascending a ladder on the rear of the tender, inspects conditions in back of the cistern, fire tools, engine equipment, etc. He immediately reports any tools that are missing in the regular equipment or any other irregular condition. When such a report is turned in, it is investigated with the enginemen before they leave the premises. All engine equipment is removed immediately on the arrival of the locomotive and is returned shortly before the time of departure. The man in charge of filling the lubricator and flange oiler is shown ascending into the cab for the purpose of filling the lubricators, etc. The work of filling the grease cups on the running gear of the locomotive is also taken care of by this man.

After this work has been completed, work reports are made out by the engineman and outside inspector which are forwarded to the enginehouse foreman by a pneumatic tube system. The inspection pit terminal for this tube system is located in the larger of the two small buildings, located north of the locomotive inspection sheds. After the outside joint inspection has been made, the locomotive is moved into the inspection shed. Fig 2 shows a locomotive in the inspection shed with an inspector checking up the height of the coupler, a mechanic packing engine truck boxes, the front end inspector opening the smoke box door to make his inspection, and a machinist tightening the left front steam chest cover. While work of this nature is going on, the inspection pit foreman makes a thorough inspection of the locomotive while standing over the pit and this report is forwarded to the enginehouse foreman by pneumatic tube. If no enginehouse repairs are needed on the locomotive, an "O.K." flag is placed on the front end which indicates that it is available for service. If the locomotive requires any heavy repairs, the inspection pit foreman places a flag marked "R.H." on the front end. These flags notify the hostler the disposition of the locomotive and he is able to take the locomotive to the enginehouse or "O.K." track after the work in the inspection pit has been completed without having to wait for instructions from the inspection pit foreman. If the inspection pit foreman is satisfied that the locomotive can be prepared for service within a short period of time, he immediately notifies the enginehouse foreman that it will be ready at a specified time. This system especially facilitates the turning of locomotives during the busy season.

Prior to the installation of these inspection sheds, the fires on locomotives were cleaned upon arrival on the ash pit. The locomotives were then washed, coaled, sanded and placed in the enginehouse where the inspectors would go over them, the work report slips would be distributed and the necessary repairs made. A close check was kept on this system for a period of six months which showed that the average time for turning a locomotive was nine hours. Since the inspection sheds have been placed in operation, with the resultant change in the system of handling locomotives, the average time consumed in fully preparing a locomotive for service from the time of its arrival off the road, has been reduced to three hours. It is not, of course, possible to have all locomotives turned in this time. Quite a number must be taken into the enginehouse for boiler wash, drop pit work, rod bushings, cylinder packing, etc., but 60 per cent of all the power going over the pit is available for service and can be turned without being taken into the enginehouse.

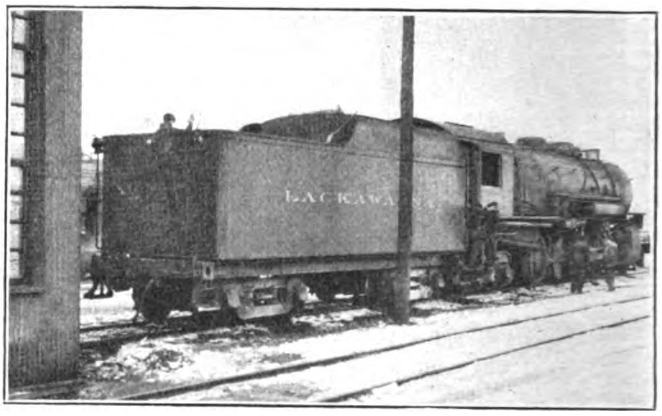
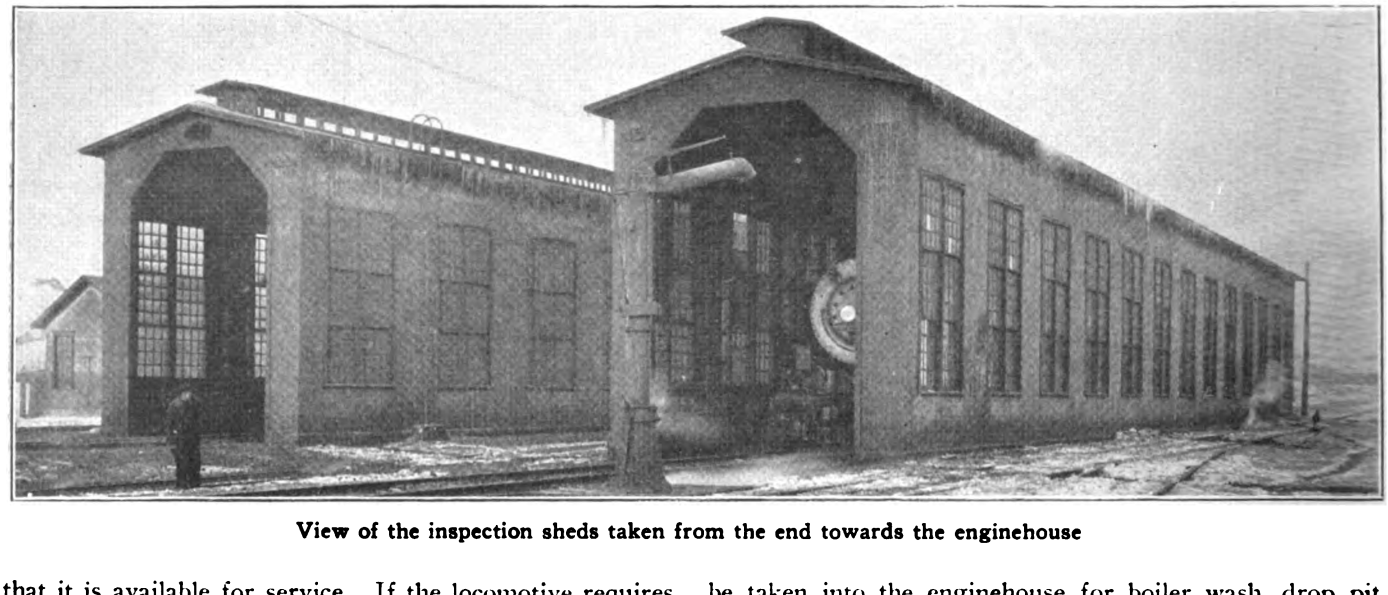


Fig. 1—Arrival of a locomotive at the inspection pit—The engineman goes over the locomotive with the outside inspector before making out his work report



View of the inspection sheds taken from the end towards the enginehouse

On account of demands for power which are peculiar to the anthracite coal business in this territory, shortage of power is encountered during the last three or four days of each week. Coal that is mined in the early part of the week accumulates in the yard and the transportation de-

partment, of course, desires to expedite the movement of this business. As a result, arrangements have been made to take care of as many heavy-repair locomotives, boiler washing, etc., on the first three days of the week so as to permit the turning of all power in a minimum time in the latter part of the week. On Mondays, Tuesdays

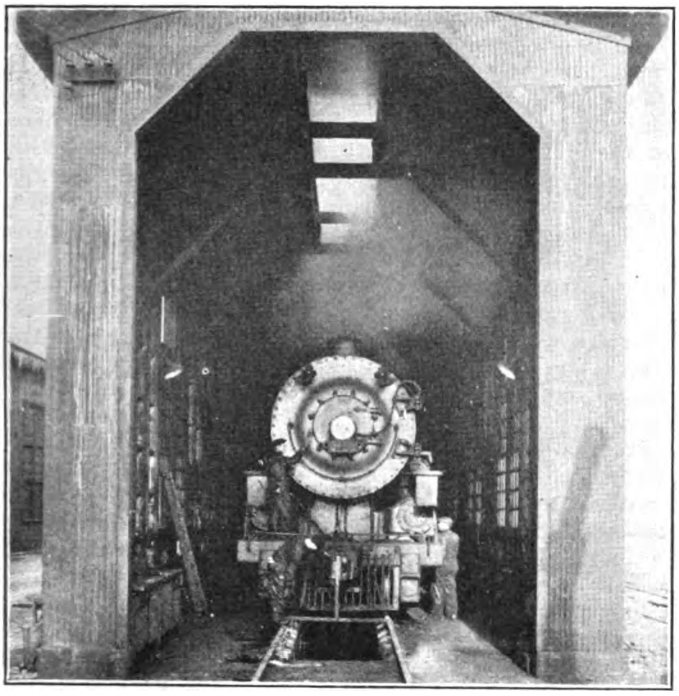


Fig. 2—A locomotive in the inspection shed—If repairs are required an "RH" flag is placed on the front end, if not an "OK" flag is placed as shown in the illustration

and Wednesdays, nine gangs are employed in the house. On Thursdays, Fridays and Saturdays, three of these gangs are taken outside to assist in the work of turning locomotives and only six gangs are used in the engine-house. It has been through the operation of this system that it was determined that 60 per cent of the power was turned on an average of three hours following its arrival at the terminal.

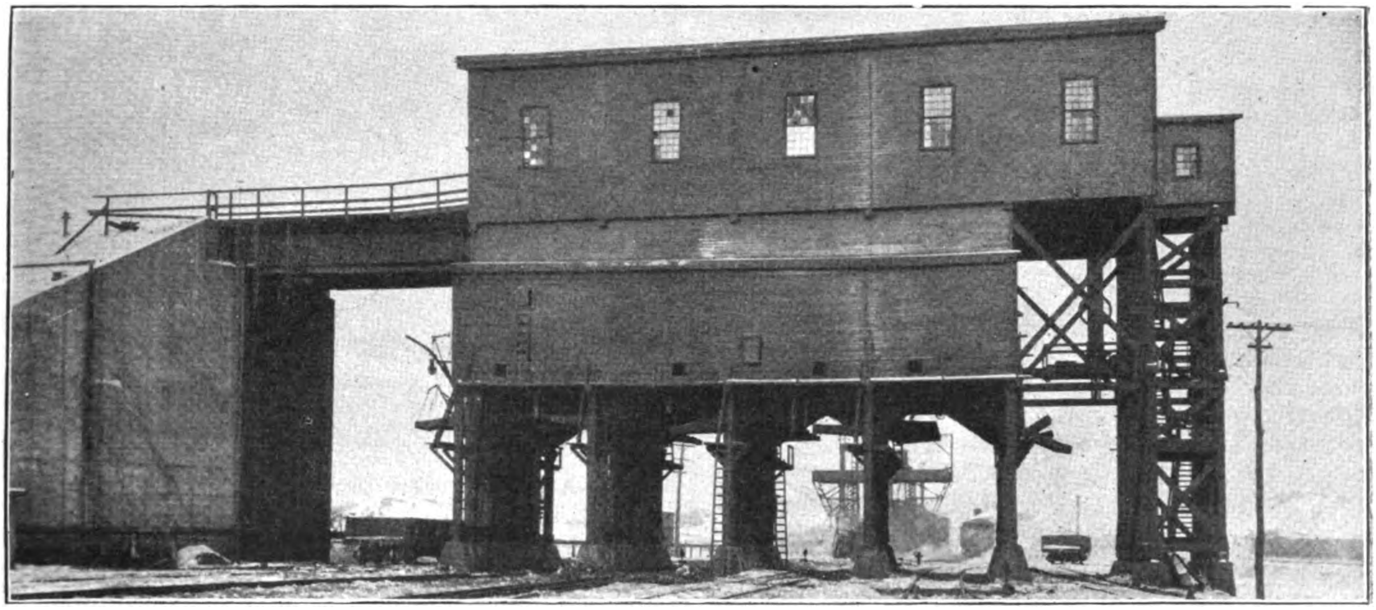
The inspection sheds are well equipped

Each of the inspection sheds are equipped with work benches located at each end where all necessary tools are provided for the man assigned to work there. The sheds are lighted by a system of flood lights placed on the walls of the shed so as to provide plenty of light on the side of a locomotive. Two of these lights are shown in Fig. 2, immediately inside the entrance to the inspection shed. A series of flood lights are also placed inside of the walls of the pits which provide excellent illumination, both day and night, underneath the locomotives. Each inspection pit is 175 ft. long and can accommodate two Mikado type locomotives.

Located adjacent to the inspection sheds is a frame building which is used jointly as an office for the inspection shed foreman and a supply room. It is provided with a telephone and is the terminal for the pneumatic tube system referred to in a preceding paragraph, through which work reports are delivered from the work report book clerks in the enginemen's board room. An annunciator is placed outside of the building for the purpose of calling the foreman when the telephone in the office rings. This can be heard at any point in the inspection shed so that the foreman can easily respond to a telephone call when wanted. All the supplies required on the inspection pit are kept in the store room compartment of this building. This compartment also contains a portable piston packing boring machine to handle the boring of all valve stem and piston packing for the handling of locomotives on the inspection pit.

Close to this building is a steel cupboard for the storage of lubricants used on locomotives that are prepared on the inspection pits. All lubricators are filled, engine truck, driving and trailer truck boxes packed, rod cups filled and stokers and boosters from this source of supply. Stokers and boosters are oiled at regular intervals and each locomotive is checked up daily to see that this particular item has been performed according to schedule.

All the leads on the incoming and outgoing tracks are equipped with water cranes conveniently located for the filling of tenders on incoming and outgoing locomotives. Two of these cranes are located between the locomotive inspection sheds and cinder pits so that the tanks can be filled as they are started through the terminal.



The coaling station has a capacity of 1,260 tons and has eight pockets

The ash pits are 200 ft. long and are of the sluice-way type covered with metal screens. Ashes are removed with a four-ton Shaw electric gantry crane equipped with a one-ton capacity clam shell bucket. After the fires are cleaned, all locomotives are thoroughly washed on the laundry pits which are located just beyond the ash pits on the way to the enginehouse. The laundry pits are provided with adequate drainage facilities and a catch basin where the dirt that is washed from the locomotives is caught and removed to the ash pit. The washing equipment used is manufactured by the D. & M. Manufacturing Company, Chicago, Ill.

The coaling station has a capacity of 1,260 tons and is provided with eight pockets all of which are equipped with undercut gates. The sand bins are also an integral part of the coaling station so that the sand dome of a locomotive can be filled by the hostler while the tender is being loaded by the coal station attendants.

The enginemen's board room is located between the coaling station and the engine house building. This location makes it convenient for the engineman to file work reports and time tickets. Standard clock service is also provided and a bulletin board is located in the room for the display of all orders and memoranda for the engine crews. This room is equipped with lockers and other facilities for the comfort of the engine crews. The work book clerks, located in the board room, have direct telephone communication with the inspection shed and this is also the enginehouse terminal for the pneumatic tube system through which the work reports are delivered. Work reports received via the pneumatic tube system are immediately delivered to the inspection foreman at the enginehouse.

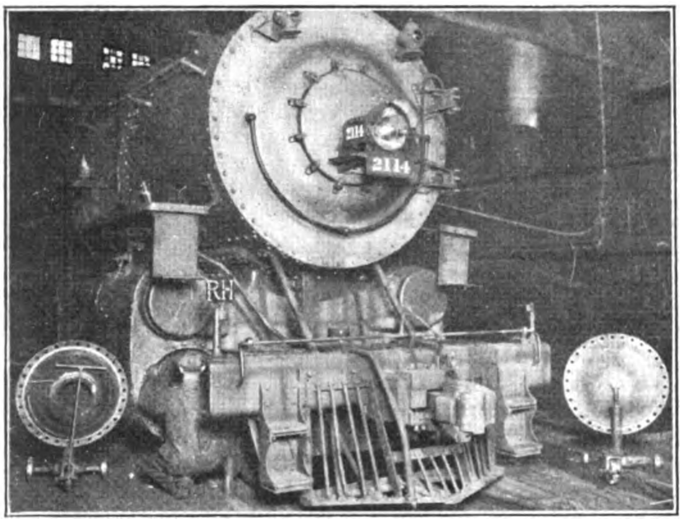


Fig. 3—Locomotive in the enginehouse for work requiring the removal of the cylinder heads

The enginehouse

The enginehouse is of brick construction and has 41 stalls. As shown in the drawing, either end of the building can be extended if necessary so that additional stalls may be added. One of the illustrations shows a general view of the enginehouse. The outgoing lead is shown at the extreme left where locomotives are prepared for departure. The incoming and outgoing leads are lined up adjacent to tracks leading to the enginehouse so that dead locomotives may be moved in and out of the stalls without the use of cables, push blocks, etc. The 100-ft. electrically operated turntable, which was recently installed, is a three-point suspension type with overhead trolley.

The enginehouse equipment includes a 50-ton capacity drop pit table manufactured by the Whiting Corporation. This table was installed about a year ago without any excavation or alteration of the pits, except to spread the rails. This table replaced two pneumatic drop pit jacks. Since its installation, all work on locomotives, such as removing and replacing engine truck wheels, driving wheels, driving wheel tires without stripping the guides, etc., driving springs and saddles, trailer truck wheels, tender truck wheels, boosters, inspection of drawbars and drawbar pins is handled on this pit. By means of this table the front end of Mikado locomotives can be raised for the shimming of the No. 1 and No. 2 tires without any additional jacking. A five-inch lift above the rails is ample to take care of this operation. With this device, the table operator is able to observe the work by riding the table while wheels are being applied and see that the boxes take the pedestal jaws properly. In the application of driving wheels, all jacking of the shoes, wedges and binders is eliminated, as these parts are blocked up on the table. The binders are set on blocks so that they can be run up into position and it is only necessary after they are once in place to tighten up the binder bolts.

Four stalls in the enginehouse are provided with a depressed rail arrangement. All locomotives equipped with boosters are placed in these stalls when due for a boiler wash. The utilization of the depressed rail arrangement permits easy access and easy inspection of boosters, drawbars, drawbar pins, etc.

Fig. 3 shows a locomotive that has been moved from the inspection pit with the roundhouse sign on the front end which indicates to the hostler that the locomotive is to be placed in the enginehouse for repairs. All the work on this locomotive is completed with the exception of the cylinder packing. When this job has been completed, the "R.H." flag is removed and the locomotive is marked "O.K." for service. A number of portable cylinder head trucks, two of which are shown in Fig. 3, have been found quite convenient in connection with removing and replacing cylinder heads.

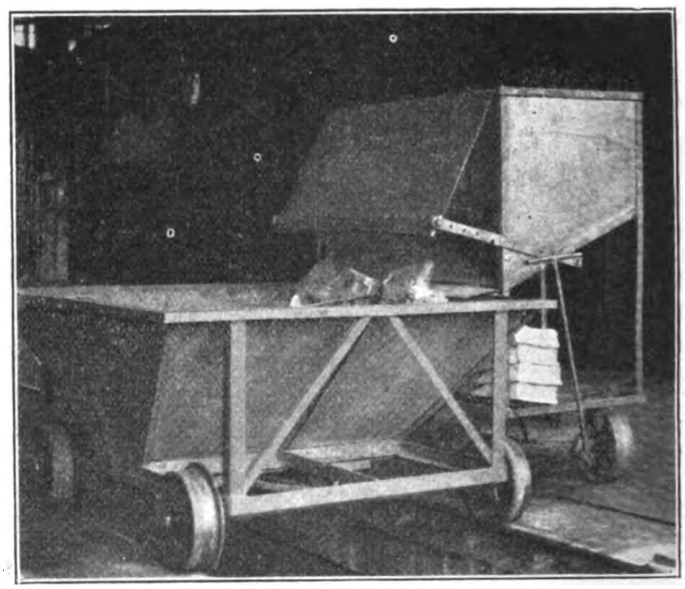


Fig. 4—A special truck is provided for handling arch brick

When the engineman reports a valve or cylinder packing blowing or any other work that is considered in the category of heavy repairs for the inspection sheds, the locomotive is placed on one of the incoming lead tracks and other locomotives are run over the adjacent track,

shown in the drawing, so that the inspection pit man can work on the renewal of the cylinder packing, valve packing rings, etc., while the locomotive is waiting to go into the enginehouse. This system keeps all of the men busy on the inspection pits and assists in maintaining production at a maximum. If the locomotive goes on the inspection pit with a loose front driving wheel tire, all other inspection pit work is completed and the locomotive is moved into one of the stalls of the enginehouse which has the depressed rail arrangement and the wheels are blocked and tires shimmed. In cases where it is necessary to reset tires on the front driving wheels, the locomotive is run over the Whiting electric drop pit table on which the tires are removed and replaced without removing the guides, crossheads or any other interferring parts which are ordinarily removed when equipment of this kind is not available.

The equipment of the enginehouse also includes both electric and acetylene welding and cutting outfits. Practically all of the boiler work is taken care of with electrical equipment and the cutting and other welding is performed by the acetylene process. An electric crane truck is used for the handling of air compressors, placing springs in position, removing and replacing driving wheel tires, etc. This truck is also used for conveying material between the storehouse and the enginehouse.

The machine shop is located in the end of the enginehouse next to the incoming lead tracks. The machine tool equipment consists of:

1 27-in. Lodge & Shipley lathe
1 12-in. lathe
1 26-in. Cincinnati shaper
2 Emery wheels
1 Babbitt furnace
1 Blacksmith forge
1 Steam hammer
1 42-in. Bullard boring mill

To facilitate the work of renewing arch brick, a special truck has been provided which is shown in Fig. 4. This truck is constructed of 1/8-in. steel-plate, supported by a frame of 1 1/4-in. angles. The different parts have been welded together by the electric process instead of being riveted. In making arch brick renewals, the new brick is piled on a platform underneath the truck bin as shown in Fig. 4 and the truck is wheeled alongside the gangway of a locomotive. The top of the truck is 80 in. from the floor which brings it to an approximate level with the floor of the cab. Old and broken brick is placed in the truck bin which is 35 in. wide and 60 in. long, the floor of which is built sloping to one side. The bin is provided with a door which opens outward as shown in the illustration so that the scrap brick can be easily removed into the hand car. The slope of the floor of the bin is 12 in. in 35 in. and the door of the bin has been placed at such a height that the scrap brick will slide into the hand car without extra handling. The hand car shown in Fig. 4, is used to handle refuse which accumulates on the floors and pits of the enginehouse. It is equipped with drop-bottom doors and has a capacity of about three tons. All dirt and refuse is loaded into these cars which are moved to the ash pit for unloading at opportune times when the tracks are clear.

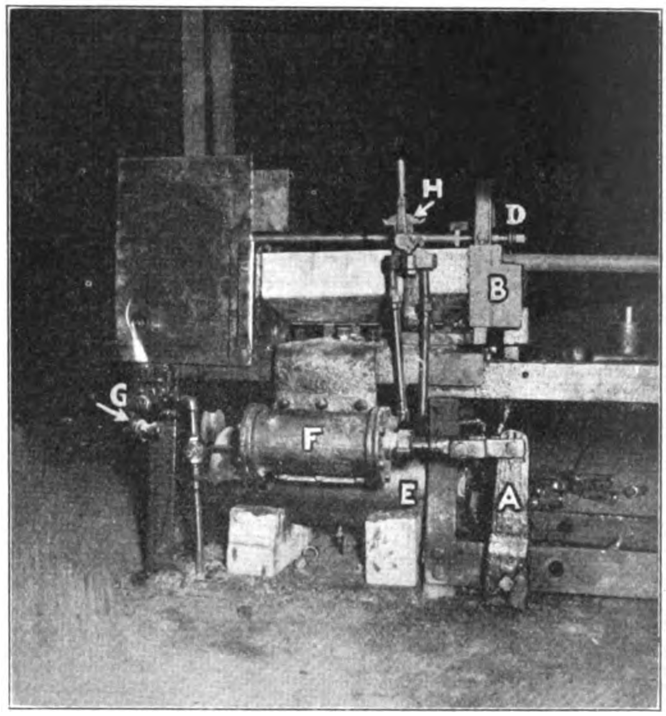
The enginehouse is also equipped with a Miller boiler washing system which is used for washing and refilling the boilers of locomotives.

East of the enginehouse is the enginehouse employees' locker and wash room and located adjacent to this building are similar facilities which are provided for the engine crews. These wash rooms are equipped with steel lockers and modern wash-room and toilet facilities. Standing at right angles to this building is a cafeteria where enginehouse employees are served luncheons by the local railroad Y. M. C. A. at moderate prices.

The Hampton engine terminal has been planned with ample room and necessary details for increasing its capacity when business requires. The enginehouse has been designed so that additional pits can be installed if necessary and the coaling station is also constructed to permit increasing its capacity. As a matter of fact, all facilities have been planned and installed with the view of possible future enlargement, and in the provision of such additions it will not be necessary to make any changes in the present track arrangement, or in routing locomotives through the terminal.

Device for cutting off flue ends for welding

THE accompanying illustration shows a device for cutting off flue ends for welding. It consists of a piece of 3/4-in. by 12-in. flat iron, bent to a right angle and bolted to the frame of a flue cutting machine. To this is bolted a 6-in. by 14-in. tank brake cylinder, which is changed from a double end to a single end pressure by removing the front packing leather and boring a 3/4-in. hole in the front end of the cylinder. A strong coil spring is placed on the front end of the piston in order to provide



Machine for quickly clamping flues when cutting off the ends for rewelding

a quick release for the roller block *B*, in which the flue revolves.

In order that any desired pressure might be applied to the flue that is cut under the knife *D*, it is necessary to have the piston under accurate control. This is done by applying a locomotive feed reducing valve *G* to the shop air line and reducing the shop pressure down to 35 lb. in the auxiliary reservoir *E* located under the machine. The air is then piped to the straight air brake valve *H*, then to the rear end of the cylinder *F*. The roller block *B* is pressed against the flue by the operation of lever *A*, one end of which is connected to a shaft which extends across the lower frame of the machine. The end of this shaft is

connected to a perpendicular push rod which is connected to the roller block *B*.

This air operated device firmly holds the flue against the cutter and greatly speeds up the work of cutting off flue ends.

A locomotive air brake feed valve test rack

THE locomotive air brake feed valve test rack, shown in one of the drawings, is being used in the enginehouses and four main shops of an eastern railroad. It is equipped with a device for clamping the feed valve to the rack, which eliminates the need of bolts for that purpose. The detail parts of the clamping device are shown in one of the drawings.

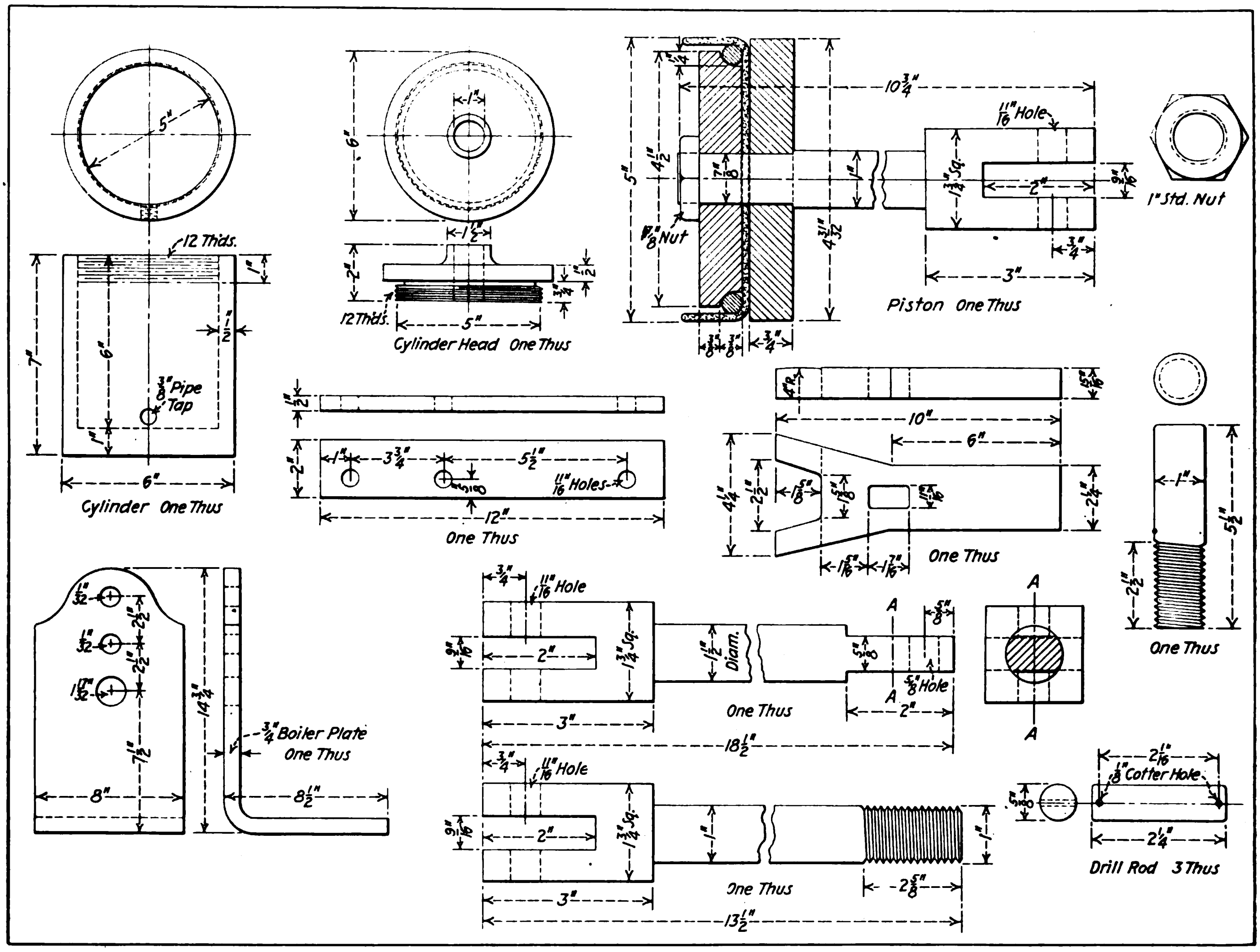
Referring to the assembly drawing of the rack, a diagram of the piping arrangement is shown at the upper right hand corner and a drawing of the assembled rack equipped with the clamping device is shown at the left. The rack consists essentially of three air reservoirs, the larger of which is used to supply air to operate the clamping device, a duplex and single pointer air gage and clamping device, together with the necessary piping, cocks and valves. This equipment is mounted on a bench, the top of which is made of 3/16-in. boiler plate. The front part of the bench rests on two legs made of 1½-in. angle iron and the rear part of the bench is bolted to one end of the operating reservoir as shown in the drawing.

Feed valves are clamped to the test rack and held in place by pressure transmitted from a small air cylinder, the detail construction of which is shown, through a system of levers to a clamp which presses against the cap nut of the feed valve being tested. This clamp holds the feed valve against the pipe bracket and is made with an opening at the bottom which fits over the hexagon portion of the cap nut. The method used for testing feed valves is given in the following instructions.

Instructions for testing feed valves

General—After the feed valves are cleaned they must be thoroughly blown out with compressed air and the parts dried with air blast and rags.

Feed valves must not be lubricated and must be assembled dry. When oil is used to lap in the valves and seats or to reduce friction, the parts must be cleaned and blown or wiped dry before assembling.



Drawing showing the detail parts of the clamping device for the feed valve test rack

Clamp the feed valve to the test rack with only the cap nut applied and with all cocks closed. Open Cocks 2 and 3 to blow out the ports leading to the regulating valve and diaphragm chamber. A strong blow must be had at these ports which indicates that the ports are fully open. Close Cock 3, apply the regulating valve, supply valve and piston to the feed valve and again open Cock 3. Leakage past the regulating valve or supply valve will

cause a blow at the regulating valve stem or small port in the diaphragm chamber. Leakage between the feed valve gasket ports will also cause a blow at the small port in the diaphragm chamber, so the gasket must be known to be in good condition before clamping the valve to the rack. After the above tests are completed coat the valve and cap nut joints with soap suds to locate any leakage and then apply the diaphragms, ring and spring box.

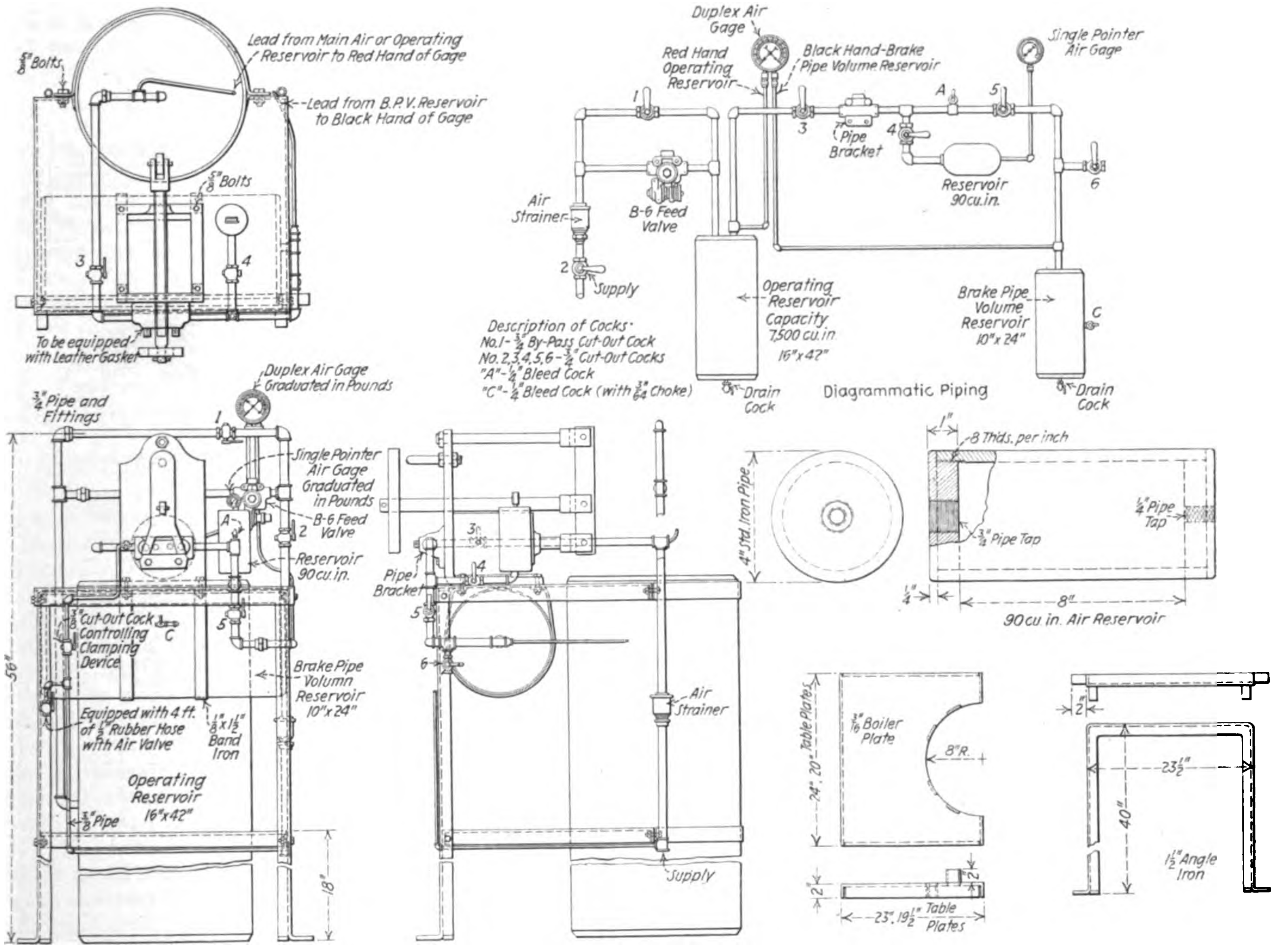
The operating reservoir pressure shall be 20 lb. higher than the setting of the feed valve undergoing test. Should the operating reservoir pressure drop below the amount necessary to operate the feed valve, open Cock 1 and adjust the feed valve undergoing the test, for 20 lb. less pressure than the amount shown on the operating reservoir gage.

Test No. 1—*Vibrating test*—Commence this test with by a rise in pressure on the small reservoir gage. This leakage should not be greater than 5 lb. in 20 sec.

Should the leakage be greater than the amount specified, remove the spring box, diaphragm ring and diaphragms. Soap the regulating valve stem for regulating valve leakage and the small port for supply valve leakage. In this way the source of leakage may be distinguished. Re-assemble the spring box, diaphragm ring and diaphragm.

Soap the entire valve for leakage. If the cap nut joints are not tight, the valve is liable to overcharge, especially when the piston becomes coated with oil or gum. At the completion of this test, close Cock 4.

Test No. 3—*Capacity test*—Commence this test with Cocks 3 and 5 open. Set the feed valve to close at 70 lb. Close Cocks 1 and 2 and with 90 lb. pressure in the



Rack used for testing locomotive air brake feed valves

all cocks closed. Open Cocks 2, 3 and *A,* then tighten the regulating nut until the valve begins to vibrate rapidly. This will be indicated by intermittent puffs of air from Cock *A*.

Allow the valve to vibrate for three minutes, except at shops equipped with a vibrating rack in which case feed valves shall be vibrated for at least three minutes before they are placed on the test rack.

Test No. 2—*Supply valve, regulating valve and casting leakage*—Commence the test with Cocks 2, 3, 4 and 5 open and Cock 6 closed. Set the feed valve at 70 lb. After charging the small reservoir to 70 lb. close Cock 5. Supply valve and regulating valve leakage will be indicated operating reservoir, close Cock 5 and open Cock 6. Then open Cock 5 and note the time required to reduce the pressure from 90 lb. to 40 lb. This time should not exceed 13 sec. for B-6 and C-6 feed valves and 16 sec. for B-3 and B-4 feed valves.

Test No. 4—*Range test*—Commence the test with Cocks 3, 5 and *C* open, and the feed valve set at 70 lb. The range between the cutting in and cutting out point should not be greater than 1½ lb. for a shop test and 2 lb. for an enginehouse test. The valve operation should be snappy, cutting in and out several times in a minute. If the range is greater than those specified above, the supply piston is either too tight or too loose. If the

overcharge on Test No. 5 is excessive, the piston is too tight; otherwise, it is too loose.

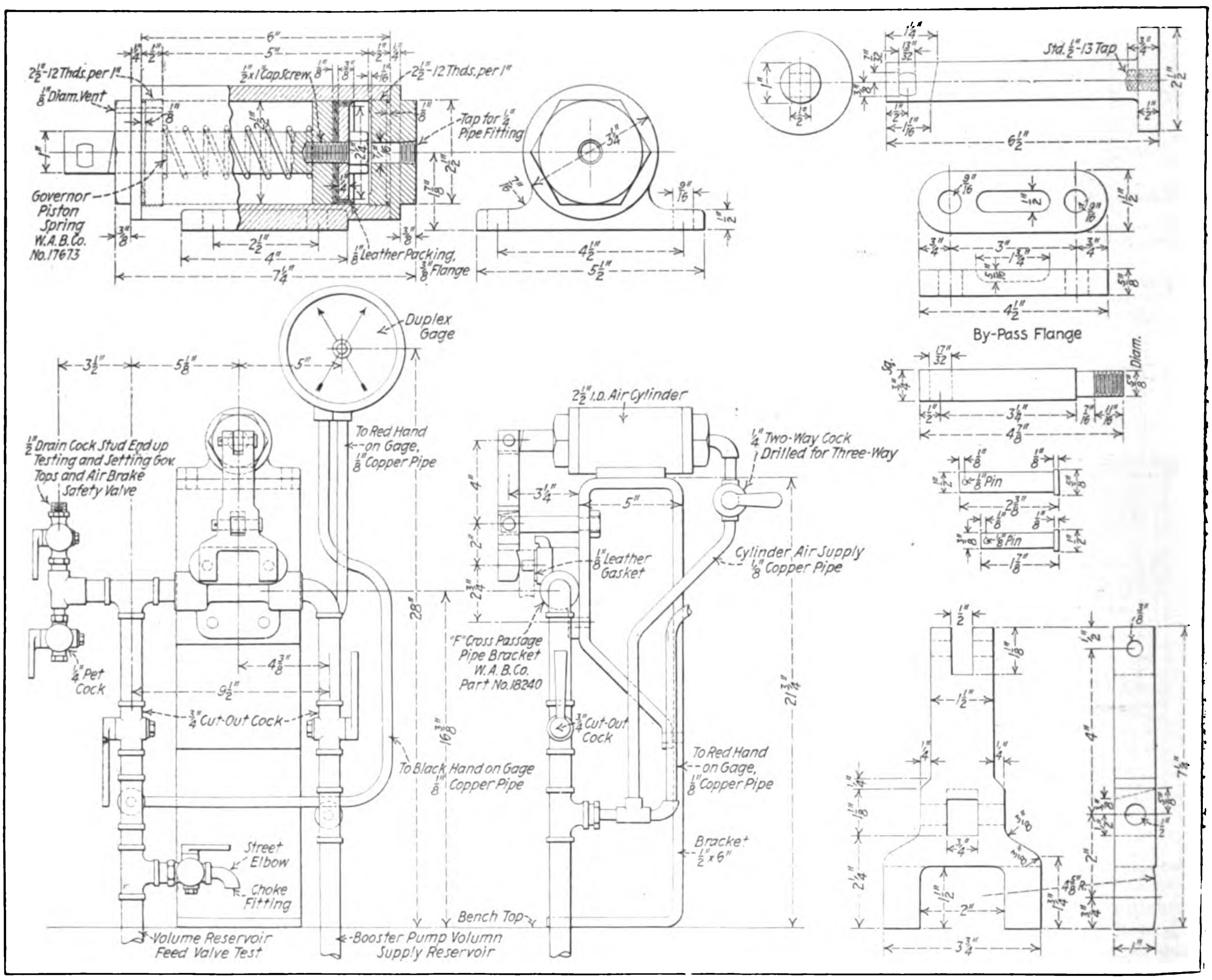
Test No. 5—Overcharge test—Commence the test with the brake pipe volume charged to the setting of the feed valve and then close Cock 3. Open Cock *A* and bleed the brake pipe volume reservoir pressure 5 lb. below the setting of the feed valve. Close Cock A, then open Cock 3 quickly and note the overcharge on the brake pipe volume gage. This overcharge must not exceed 2 lb. At the completion of this test, close Cocks 3 and 4 to remove the valve.

Feed valve test rack clamp

By H. J. Duernberger
Air brake repairman, Niles, Mich.

Every time a feed valve is put on a test rack two ½-in. nuts have to be put on and removed. This requires considerable of the tester's time and the purpose of the clamping device shown in the illustration is to reduce this time to a minimum. It consists of a ½-in. by 6-in. bracket mounted at the rear of a work bench and for convenience about 3 ft. from a bench vise. A 2½-in. inside diameter air cylinder is bolted to the top of this bracket. The fork shaped clamp arm swivels on a ½-in. pin which passes through the end of the 1-in. air cylinder piston. The clamp arm fulcrums on a ⅜-in. pin which passes through a ¾-in. square stud located 4-in. down from the center line of the air cylinder piston.

The assembled view in the illustration shows the clamp in the set position. When the air is released, the clamp arm moves to an angle sufficient for removing and replacing a feed valve. The by-pass flange shown is clamped on the rack when testing air brake safety-valves or pump governor tops.



Device for clamping feed valves to a test rack

The Southern Pacific is now running passenger trains between El Paso, Tex., and Houston, a distance of 832 miles, without changing locomotives, and thus exceeding slightly the longest runs previously made on the same road between El Paso and Los Angeles, Cal., 815 miles. The Houston-El Paso run was established on April 4, when the runs of trains Nos. 7 and 8 were extended and the change of locomotives at Del Rio, the former intermediate terminal, was discontinued. The Argonaut, a New Orleans-San Francisco train, was established on the same date, thereby making possible the long runs. Five Class C5 locomotives are used in the new long runs, with four in constant use and one in reserve. The saving in locomotives is indicated by the fact that only a few years ago five locomotives were used to draw a single train from Houston to El Paso, the divisions being from Houston to San Antonio, to Del Rio to Sanderson, to Valentine to El Paso. Thus it took 20 locomotives to handle the four trains making that route daily.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Case hardening Walschaert gear links---a question

PARSONS, Kansas.

TO THE EDITOR:

I get a great deal of help from the articles that are published in the *Railway Mechanical Engineer* and appreciate the opportunity you have given the readers to ask questions in the "Readers' Page."

We are experiencing difficulty in case hardening the large Walschaert valve gear links; that is, preventing them from warping out of shape while straightening to the proper radius, or getting them sufficiently close to the right dimensions so that they may be ground without removing any of the hardened surface.

I feel sure that some of the readers of the *Railway Mechanical Engineer* have been successful in overcoming this difficulty. I would like to hear from them.

MAURICE J. MCCABE.

The future locomotive boiler—A defense of the present type

CHICAGO.

TO THE EDITOR:

The locomotive boiler is wonderful in its simplicity and adaptability, ranging from the "teapots" of the 60's to the Mallet, Santa Fe and Texas types of the present day.

The article on "Future Possibilities of the Locomotive Boiler," in your April, 1925 issue, discussing high boiler pressures and water tube types is interesting and would perhaps be more authoritative, if less assertive, on some rather debatable points.

In discussing objections to a water tube boiler, the statement is made that fire tubes of the present locomotive type boiler are entirely unsupported except at the ends. How about the water support? A 2¼-in. by 20 ft. tube weighs 43.72 lb., but displaces 30.4 lb. of water, reducing its weight as affecting its supports to 13.3 lb. A water tube on the contrary has no such support or discount of weight and may need help in support in the event of service shocks.

The more important points which are debatable are, that water cooled surfaces have chilling effect on combustion and heat transfer and the improvement of that condition by the use of fire brick. Apparently the writer has overlooked or discounts the available authorities.

Let me quote some conclusions from an article by A. G. Christie, Professor of Mechanical Engineering at Johns Hopkins University, published in *Power* of May 29, 1923, entitled "The Influence of Radiant Heat on Furnace Design," and recommend a thorough study of the analysis leading to those conclusions. Professor Christie, in reference to stationary boiler construction, says, "it is not advisable to obtain the highest temperature possible in the furnace, for firebrick walls will not stand such temperatures." "On account of the limitations of brick work, one is compelled to sacrifice boiler efficiency." He recommends for the side walls of furnaces, instead of brick, banks of water tubes with brick only for necessary filling of interstices, or water leg side walls as in locomotives for higher efficiencies.

He quotes Scotch Marine boiler tests, showing 78.3 per cent boiler and furnace efficiency. Another set of tests ran 73.9 per cent to 77.9 per cent hand fired, coal, and 80.2 per cent to 84.6 per cent with fuel oil. Manning boiler tests with powdered fuel showed 82.2 per cent to 86.1 per cent. All of these types have completely water cooled walls and no brick work. Many locomotive tests at the St. Louis Exposition gave boiler efficiencies over 75 per cent and several were over 78 per cent.

It is thus shown by the tests quoted that a large per cent of radiant heat absorption surface in the furnace "has no deleterious effect on furnace temperatures."

Recent locomotive boiler tests, of which the writer is on record, showed that practically a doubling of the coal rate and development of heat units increased the firebox temperature only 18 per cent. There was very slight increase of temperature of gases in the flues and front end. Where did the heat go to? Prof. Christie gives the answer. It was absorbed by radiation, practically direct to heating surfaces in the firebox without materially affecting the temperature of gases in the firebox enroute to the flues, and these gases are mainly inert, not contributing to heat production, but to heat carrying or convection, the only form of heat transmission in the flues, and to some extent re-enforcing the direct radiation while passing through the firebox.

The only practical use of fire brick in a locomotive boiler is as a baffle and reflecting surface where its use, say as an arch, is very beneficial, but it should not replace or obstruct the heating surfaces from the opportunity of heat absorption by whatever mode it is available.

The author's conclusion that burning gases are cooled by premature contact with water cooled surfaces is also without foundation by analysis of front end gases over various rates of combustion. See Lawford Fry's "Study of the Locomotive Boiler."

There is, of course, a high loss of unburnt fuel inseparable from high coal and draft rates, but this combination would have such effect whether the furnace walls were all water cooled or of brick; being mechanical rather than thermal. Increase of firebox and grate proportions are seen on modern power and are giving the benefit of reduced coal rates. The question of necessary draft for air supply with lowest cylinder back pressure is still with us, and far more important than is generally considered.

The author properly ascribes some advantages of circulation of the water of water tube boilers, presumably of the stationary types, which are built around a theory of circulation, both of the water and of the gases, tending to promote safety, uniform structural temperatures, cleaner boilers and increased evaporative efficiency. The serviceability, economy and efficiency of such boilers can very well be studied in comparison with the ordinary locomotive type and it will be found feasible, by well demonstrated means in extensive use, to supply a degree of water circu-

lation corresponding to that in the water tube stationary boiler and obtain corresponding benefit in service operation.

The psychology of the development of railway facilities leads one to believe that the locomotives of 50 years hence will mainly be steam driven and the result of further development of principles now common, but not yet well understood or appreciated.

C. A. SELEY,
Consulting engineer.

The lost circus car

MINDEN, LA.

TO THE EDITOR:

We had a young yard master
Who had been workin' mighty hard,
To get himself promoted
From switchin' in the yard.
He wanted to be super
And, bein' pretty young,
They promoted him train master,
Which put him up a rung.

He was full of pep and vigor,
And he had a lot of brains,
Though he seemed a sort of youngish
To be mastering of trains.
One day we had a circus
A showin' in our town,
And they must get a goin'
As soon as tents were down.

I was mechanical foreman,
And he, the master brain.
'Twas up to me to furnish power,
That would move the train.
The cars were set on one and two,
The crummy, on number three.
The master had the crew lined up,
And came and said to me.

"No use for you to stick around,
Things are settin' jake.
When their stuff is loaded,
I've but three moves to make.
Pull the cars off number one,
And couple into two,
Drag down, pick up the crummy,
And bid this place 'skidoo.'"

When, next morning I came down
There stood a circus car!
I looked around, to see how come;
In each end was a good draw bar,
Everything was right in place
And not a thing a draggin'.
The car was loaded with some tents,
And also, the band wagon.

Some roustabout had pulled the pin
On a car on number two!
And the crew had checked them
In two cuts. (Which ain't no way to do.)
We had to run a special train,
And without a bridle on,
To get that tent and wagon
Down where the show had gone.

With all kinds of supervision:
Three men, all tried and true,
Train master for the circus
With our train master too,
Conductor—with three brakemen—
And yet, they lost that scow!
(Don't say a word about this,
For that guy's our super now!)

J. B. SEARLES.

Lateral motion and engine truck hot boxes

ROCK ISLAND, ILL.

TO THE EDITOR:

The editorial regarding engine truck lubrication published in the February issue of the *Railway Mechanical Engineer* has brought to my mind the experience that I have had with this problem. During the ten years I have served in an enginehouse as a machinist and foreman, I have always noticed that when an engine truck hot box occurred, invariably excessive lateral motion was found. The I. C. C. allows one inch lateral for a swing bolster truck. This means that on a journal 10 in. long 10 per cent of the wearing surface is throwing off the oil owing to centrifugal force. Do you wonder that with ten per cent of the surface always free to throw out oil that the supply becomes exhausted on long runs at high speed? I take it that the trouble is practically confined to the lately established long runs.

Another point not to be overlooked is that the 10 per cent surface is often to receive all kinds of grit and dirt which helps to make hot boxes. I have noticed when we change a pair of engine truck wheels and take up the lateral motion, that the journals run a long time before causing trouble, again proving to my mind that the trouble is in proportion to the lateral motion.

GEORGE H. ROBERTS,
Foreman, Chicago, Rock Island & Pacific.

Individualism in apprentice training

SPRINGFIELD, MO.

TO THE EDITOR:

I have read with much interest the article in your March number by C. Y. Thomas on the standardization of apprentice training.

There is some discussion as to whether or not our public school educational system is catering to mediocrity. In a word, are we not handicapping the brighter pupils by holding them to the standards and progress of the slower ones? The subject has been ably discussed, pro and con, from educational, economic and social viewpoints, and will not be commented upon here, except as one of the possible dangers of standardization in educational work.

The controversy between the proponents of extreme individualism and the advocates of extreme socialism in educational systems is age-old and since it cannot be settled until individuals are standardized—which, Heaven forbid—we work on a compromise by socializing, to a great extent, the elementary schools and individualizing the higher institutions if one may be allowed to so express it.

Regardless of whether we ought to be governed in trade schools by the democratic theory of the greatest good for the whole student body or the individualistic theory of selection and advancement of the fittest, there is no doubt

about the viewpoint of the apprentice receiving trade school, continuation, or vocational training. He is not concerned with a horizontal elevation of a whole craft, but is individualistic to the nth degree. Of course, he is unconsciously fitting into the general betterment scheme, but it is safe to say that this is purely involuntary on his part.

Having in mind this extreme individualism on the part of the average boy at the apprenticeship period, ought there be any attempt at repression of his ego by any standardization of instruction, however slight that standardization may be? This will always be a moot question and the writer frankly aligns himself with the advocates of individualism and against standardization of methods, texts, etc. On the face of it, it would appear that the establishment of a standard text-book on mathematics, for example, would be beneficial; *that* science is based on standardized principles, but even here we run into the snag of individualism since hardly any problem is presented in such language as to be readily comprehensible to all students. Even in the simplest problems we have to adopt a diversity of presentation. We say seven times thirty equals ——; or seven multiplied by thirty is equal to ——; or the product of thirty and seven is equal to ——, and each of these expressions, while meaning exactly the same thing, causes a different mental reaction in various pupils. The cause of these various mental reactions is left to the psycho-analyst for consideration; but that such a condition exists there can be no doubt.

With this in mind, text-book publishers have endeavored to present as great a diversification of treatments of the same principles as is possible without making too bulky a volume; but an exhaustive treatise interesting to every type of student is still a dream of educators.

What has been said about mathematics is almost equally true of mechanical drawing. The basic principles have been standardized to the point where they can be understood, regardless of locality, but they still have to be presented differently to be grasped readily by different mentalities. Hence, a vast number of texts on this nearly standardized subject; all of these texts contain much of general interest and paragraphs or whole chapters of special appeal to some particular group or class.

Admitting that the trouble starts with the author's projection of his own ego into the work—his emphasis on those features that make special appeal to his thought on the matter—it is still doubtful whether any text-book could be made standard even though it represents the thought and work of a committee of educators.

Mr. Thomas' suggestion that conferences between apprentice instructors of various carriers should be held is certainly practical. The teachers, institutes and meetings held in nearly every part of the United States have proven their worth to such an extent that attendance is now generally made compulsory for all active teachers within the district served by the conference on institute.

Now, then, Mr. Thomas, wasn't your unspoken thought about standardization really this: "Bring apprentice instruction on all carriers up to the highest existing standards and then by interchange of instruction methods and ideas set about bettering the best that we now have?" With this thought everyone connected with the transportation industry must be in agreement, or else confess complete indifference to the future of the industry.

Of course, this is suggesting that we set up a "yard-stick" by which to measure what we are now doing in various ways to suit different localities and conditions. The writer admits having worked for many carriers and still having his "yard-stick" system by which he gages the service rendered by the various railways by whom he has been employed.

Will you pardon the pleasantry, Mr. Thomas, when we suggest that the apprentice system which you probably have as your "yard-stick" is almost a model for the entire country and that we do not blame you for measuring the efforts of other carriers in apprentice training by *your* "yard-stick."

The words "almost a model" are used advisedly in the foregoing paragraph, having in mind the varying educational progress in the several states of the Union and hence the varying development of the apprentice material available to the carriers. With the rigid selection of apprentices possible in some sections, it would probably be feasible to transfer the apprentice system of the Santa Fe, bodily, to the railways of these progressive regions. In regions where educational progress in the public schools has not been so rapid, it will probably be some years before apprentice training standards are brought to the point of development of which we all like to dream. In the meantime it would seem to be eminently practical for all of us who are interested to try to formulate, not a set of standards for apprentice schools, but a set of minimum requirements for facilities and courses, which can be amplified to suit the most advanced groups of students and still be applicable to the least fitted. Let's call them "minimum" requirements rather than "standards"; the word standards suggests too much inflexibility in something in which there can be nothing but progression.

WARREN ICHLER.

Locomotives in Australia—a correction

NEW SOUTH WALES, Australia.

TO THE EDITOR:

I wish to correct a statement that appeared in the January issue of the *Railway Mechanical Engineer*, page 19, which stated that a three-cylinder, Pacific type locomotive with a tractive power of 40,000 lb. at present being built by the Victorian Government Railways, would be the most powerful locomotive in Australia.

Certainly this locomotive will be the most powerful Pacific type locomotive in Australia, but the distinction of owning the most powerful locomotive in Australia belongs to the South Australian Government Railways which has recently imported from England, 30 locomotives—10 Mountain, 10 Pacific and 10 Mikado types. The respective tractive forces of the three types are, 51,000 lb., 36,600 lb., and 40,400 lb. You will, therefore see that the Mountain type represents the most powerful locomotive in Australia, and for your convenience I have given the principal weights and dimensions of these locomotives.

Railroad	South Australian Government
Type	4-8-2
Cylinders, diameter and stroke	26 in. by 28 in.
Driving wheels, diameter	63 in.
Steam pressure	200 lb.
Heating surface, tubes	2,190 sq. ft.
Heating surface, large tubes	1,088 sq. ft.
Firebox and arch tubes	331 sq. ft.
Superheating surface	835 sq. ft.
Grate area	66.6 sq. ft.
Stoker	Duplex
Adhesive weight	91.1 tons
Ratio of adhesion	4.00
Tank capacity, gallons	8,000
Fuel	12 tons

C. S. EDWARDS.

THE GREAT NORTHERN has adopted a plan whereby, with the co-operation of the Pullman Company, the dining, sleeping and observation cars of the Oriental Limited will be remodeled so as to include any new service feature of recent origin. The cars will be sent at regular intervals to the Pullman shops where the new features will be installed. Each of the 10 trains now operated is being furnished with porcelain washbowls.

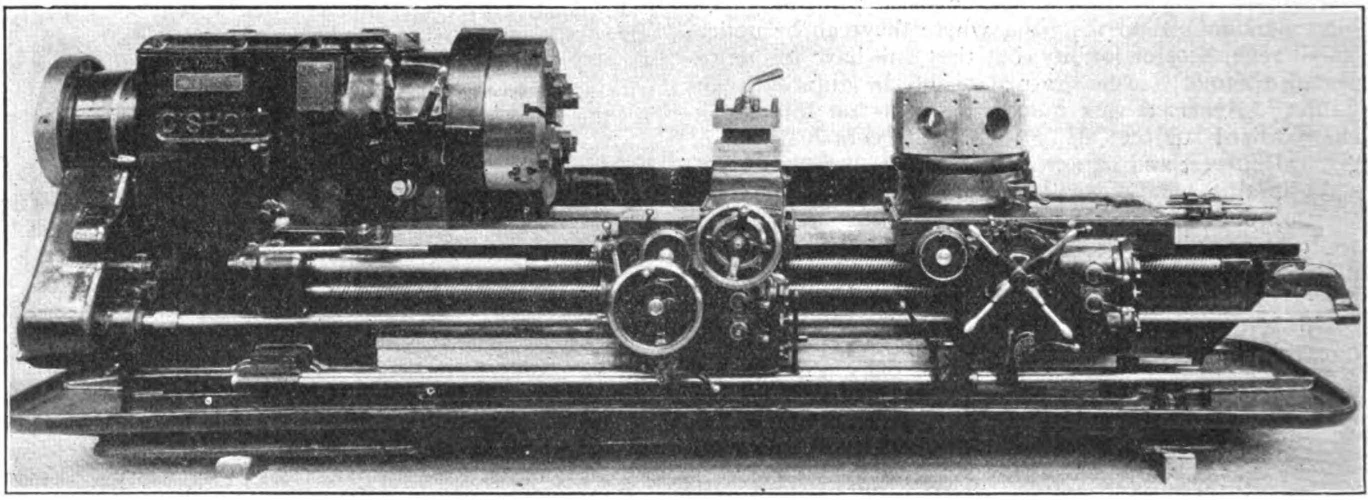
New features in Gisholt turret lathes

TO meet the demands of present day production through greater power and increased ease of operation, a new line of heavy ball bearing turret lathes has been placed on the market by the Gisholt Machine Company, Madison, Wis. Two sizes of the new machines are now in production, the 3L having 21 in. swing and 4½-in. and 5-in. bar capacity, and the 4L having 28 in. swing and either 9-in., 10-in. or 12-in. bar capacity. In each size, two types are available, one with a fixed center turret and the other with a crossfeeding turret, both types having the full swing side carriage with square turret tool post. Either model is adapted for the general range of production work, and the cross feeding turret is especially useful for small lot production, railroad work, toolroom and die work, as it permits the use of extremely simple tooling and quick set-ups. Short, stiff tool holders with forged tools may be used for facing and boring in place of the facing heads and double end boring cutters required where the cross feeding feature is not available.

Notable features of the general design are, ball bearings on all shafts transmitting power, and ball thrust bearings for the main spindle and feed nuts; alloy steel heat treated gears; multi-disc friction and brake; complete independent feeds to each carriage with unit assembly of feed mechanisms; rapid traverse for each carriage independent of the feeds; automatic feed and traverse trips; micrometer dials with observation stops; double bevel turret clamp ring and index bolt operated by one lever; steel forged spindle with bronze bearing boxes tapered in housing for adjustment, and adjustable from outside; and hinged motor mounting.

A heavy cast iron pan supports the machine as a sub-base or foundation. It comprises a series of chambers formed by ribs running transversely and lengthwise, which give the pan rigidity without excessive weight. The chambers next to the edge of the pan are covered with heavy perforated sheet steel secured by counter-sunk screws and presenting a smooth, flat surface. The sheets are supported by bosses projecting from the bottom of each chamber at frequent intervals so that a casting dropped on the sheets or a shovel removing chips will not injure them. As the cutting lubricant falls from the tools upon these sheets, it is strained at once and drained back through the chambers to the central reservoir without accumulating in the pan.

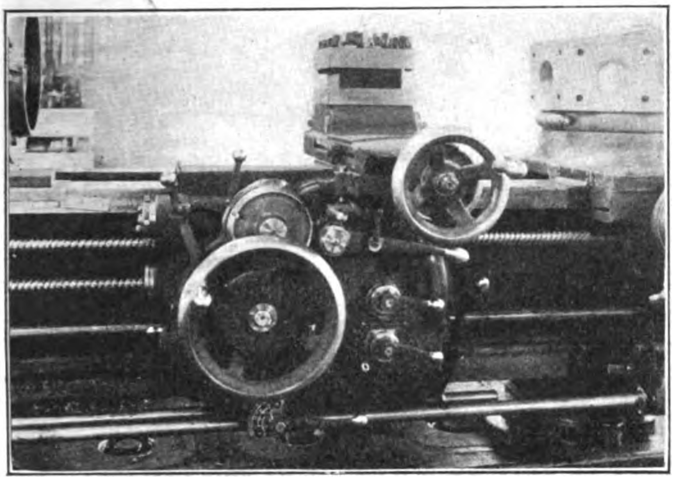
The bed of the machine is of heavy box section ribbed laterally every 12 in. with a center rib extending up under the headstock. The ways are wide and flat, both front and back, with an under-cut way low down on the front for supporting the apron of the side carriage. The walls of the headstock have been carried well up above the



Gisholt high power ball-bearing turret lathe with 28-in. swing and 9-, 10-, or 12-in. bar capacity

spindle bearings and a plate on top presents a flat surface to receive the motor base. The motor base is hinged so as to swing back and give access to the headstock without removing the motor.

The drive is through a 5-in. belt on the 3L machine, from a recommended 15-hp., 1200 r.p.m. motor to a single 18-in. pulley which rotates at 500 r.p.m., and is provided with an outboard ball bearing and is enclosed for safety. On the 4L machine the drive is through a 10-in. belt from a recommended 25-hp., 1200 r.p.m. motor to an



The powerful carriage construction and convenient location of operating levers are evident in this view—Note the separate lead screw to each carriage

18-in. single pulley rotating at 450 r.p.m., and on this machine the motor pulley, as well as the drive pulley, is supported by outboard ball bearings located in the surrounding housing. Sixty-three large ball bearings are used in each machine.

The headstock comprises a drive shaft carrying a double multi-disc friction and a multi-disc brake, an intermediate shaft with the necessary gearing, and the spindle which carried the two driving gears, one on either side and close up to the front bearing. The drive shaft and intermediate shaft are carried in annular ball bearings, and the spindle is held in bronze sleeve bearings tapered on the outside for adjustment. The collars for adjusting the tapered spindle bearings have gear teeth cut on their circumferences, and the wrench provided carries a gear segment on one end. This segment is cut about a hole as a center, into which a sliding pin held in a boss on the front of the headstock is inserted and acts as a fulcrum in adjusting the bearing for high speed work or heavy cuts. This adjustment is made from the front without raising the headstock cover. The spindle thrust is taken on a large ball bearing located just back of the chuck gear.

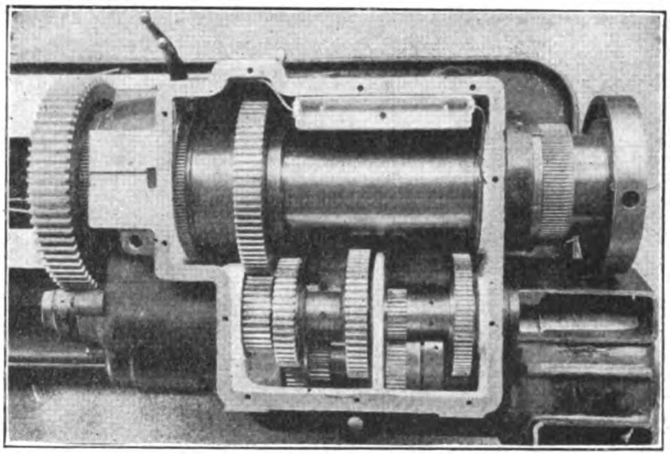
The multi-disc friction on the back shaft is double and is thrown to either side when starting, depending on the speed desired, and when it stands in neutral the multi-disc brake is engaged. Both clutch and brake are made of alternate discs of soft steel and phosphor bronze.

Eight speed changes in geometric progression, ranging from 8 to 257 r.p.m. of spindle, are available. The entire headstock runs in a bath of oil, and a special oil well supplies the front spindle bearings. The chuck gear is keyed to the spindle flange, while the spindle itself has a threaded nose for receiving various types of chucks and fixtures, this nose having a taper back of the thread for centralizing the fixtures or chucks and allowing them to be attached with a metal to metal fit.

The feed train is carried from the spindle on a series of ball bearing shafts down to the feed shaft. A separate lead screw is provided for each carriage, which revolves only when driven by the rapid traverse mechanism. When the carriage is feeding, the lead screw stands still and the feed shaft, through a ball bearing gear train in the apron, rotates the nut about the lead screw. When the rapid traverse is engaged, the lead screw runs ahead of, or in the opposite direction to, the feed, which is still operative at the end of the traverse unless disengaged. Eight reversible feed changes are provided in each apron, and additional feeds may be secured by pick-off gears in the headstock end. Feeds from 1/256-in. to ½-in. per revolution, and all standard threads, are secured through one set of change gears, and special change gears may be provided when required. The hand wheels on both carriages are so geared to the lead screw nut through a differential gear that one revolution of the hand wheel moves the carriage one inch. When thread chasing, the wheel is locked by a plunger pin which facilitates catching the thread at each pass. An observation dial for the longitudinal feed is located on each carriage, graduated and geared to show 7 in. of circumferential movement for each 1 in. of carriage travel, and several adjustable clips are provided on the beveled circumference to act as observation stops. In addition, both carriages are equipped with automatic feed trips and the tool post cross feed dial is graduated in thousandths.

The two aprons are duplicates as to internal parts, and the several sub-assemblies of parts may be removed as units by removing end plates or front plates. The lubrication of the differential gear is from a central reservoir in each apron.

The rapid traverse is at the rate of 40 ft. per min. for each carriage independent of the feeds, and the pilot wheel on the turret carriage is automatically locked against rotating when the rapid traverse is engaged. The rapid



Adjustments of taper spindle bearings, shown with the gear teeth cut on their circumferences, may be made from the front without raising the headstock cover

traverse mechanism is mounted as a unit in the rear of the headstock, and is belt-driven direct from the drive pulley.

Four automatic longitudinal trips are provided for the tool post carriage, six longitudinal trips for the turret carriage, and automatic trips for the cross feed are provided. The stop rod for the longitudinal feed of the square turret is graduated in inches and mounted on an arm that can be swung out of the way when it is desired to have the square turret side carriage pass the chuck.

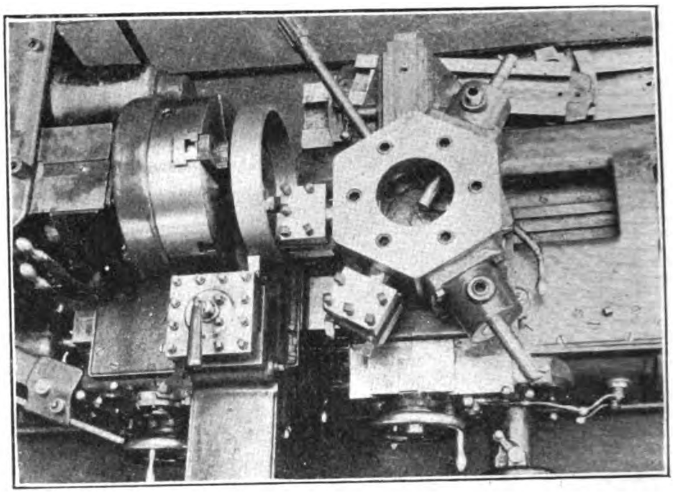
The base of the hexagon turret has a beveled flange with a 12 deg. taper corresponding to a similar taper on

the top of the carriage slide. The two sections of the clamp ring are beveled internally to match, and are drawn together by an eccentric and lever having a mechanical advantage of 80 to 1, thus holding the turret securely against turning or lifting. The usual index bolt for positioning is of course provided.

The six turret stop screws are arranged in groups of three in separate heads. Each head can be moved quickly by withdrawing the pin that positions it in one of a row of holes 1 in. apart, and fine adjustment of each stop is obtained by screwing it through the head. Coarse adjustment is made rapid by backing out a hollow head set screw, to which is attached a segment of a nut, thus permitting the stop to be slid through to approximaely the point desired.

The taper attachment, of large proportions, is attached to the rear of the bed. It will turn tapers up to a maximum of 6 in. taper per foot in lengths of 15 in. On the fixed center turret type of machine, the taper attachment is connected with the square turret on the side carriage; on the cross feeding turret unless otherwise specified by the purchaser.

These machines are regularly furnished with heavy steel body, three-jaw geared scroll chucks, but four-jaw independent chucks, air-operated chucks or collet chucks are available. The bar feed can be furnished, and on the larger machine a power angular feed to the square turret tool post for angles beyond the reach of the taper attachment. The weight of the bare machines is approximately 11,000 lb. for the 21-in. machine, and 19,000 lb. for the 28-in. machine.



Turning this view through 90 deg. shows the resemblance to side head boring mill with powerful turret and side head design—Note rugged taper attachment

Electro-magnetic automatic furnace

THE process of correctly hardening all steel consists of heating it to exactly the right degree to obtain the finest grain size and then fixing this altered arrangement of the molecules as a permanent structure by quenching the steel in water or oil. The Wild-Barfield electro-magnetic furnace recently placed on the market by the Automatic & Electric Furnaces, Limited, 175 Farringdon Road, E. C. 1, London, England, has been designed to obtain correct results when hardening steel.

A corner of a fully electrically equipped hardening shop

The equipment consists of an electrically heated furnace and a control panel in electrical connection with it. The furnace consists essentially of a special refractory chamber surrounded by a closely wound helix of alloy wire, the electrical resistance of which produces the necessary heat. A controlling resistance in the circuit of this coil permits of varying the strength of the current and thereby the heat of the furnace. Superimposed on this main heating winding is the secondary or indicator winding electrically connected to the magnetic indicator on the control panel. The whole furnace unit is thoroughly lagged to reduce heat losses to a minimum, and is surrounded by a substantial case of polished aluminum with end castings of soft grey iron.

The control panel, in addition to carrying the magnetic indicator by which a visual indication of the magnetic condition of the charge is given to the operator, it also carried the regulating rheostat for controlling the furnace temperature; the warning lamp of the excess temperature cutout and a pyrometer (if required) solely for regulating the superheat of the furnace.

The horizontal bench type of electric furnace

The electrical circuits of the complete equipment consists of the primary or heating winding on the furnace chamber; the secondary or indicator winding on the furnace casing; the secondary and primary windings of a coil generally designated as the compensator; the moving coil

of the magnetic indicator and the winding on an electromagnet between the poles of which the coil of the magnetic indicator moves.

Normally an electro-motive force is induced which is opposed and completely neutralized by an equal electromotive force. As soon, however, as a piece of steel is introduced into the furnace, the electromotive force is augmented by the presence of the steel, the electromotive force opposing it is overpowered and a small current circulates through the moving coil of the magnetic indicator causing it to move on its axis, the pointer generally being deflected across the scale to a stop, against which it vibrates giving rise to a musical note so long as the steel is in the magnetic condition.

As soon as the steel has nearly attained the non-magnetic condition, i.e., the correct point for quenching, the pointer leaves the stop and comes slowly down the scale till finally it stops when the steel has lost its last trace of magnetism.

In addition to the indicator attachment every furnace is fitted with an excess temperature cutout. This unique device consists of a thermal fuse which automatically blows whenever the temperature of the furnace is accidentally allowed to rise to a point likely to endanger the heating windings. When this cutout comes into operation a red pilot lamp on the control board is caused to glow, thus warning the operator, and at the same time the main heating current is switched off.

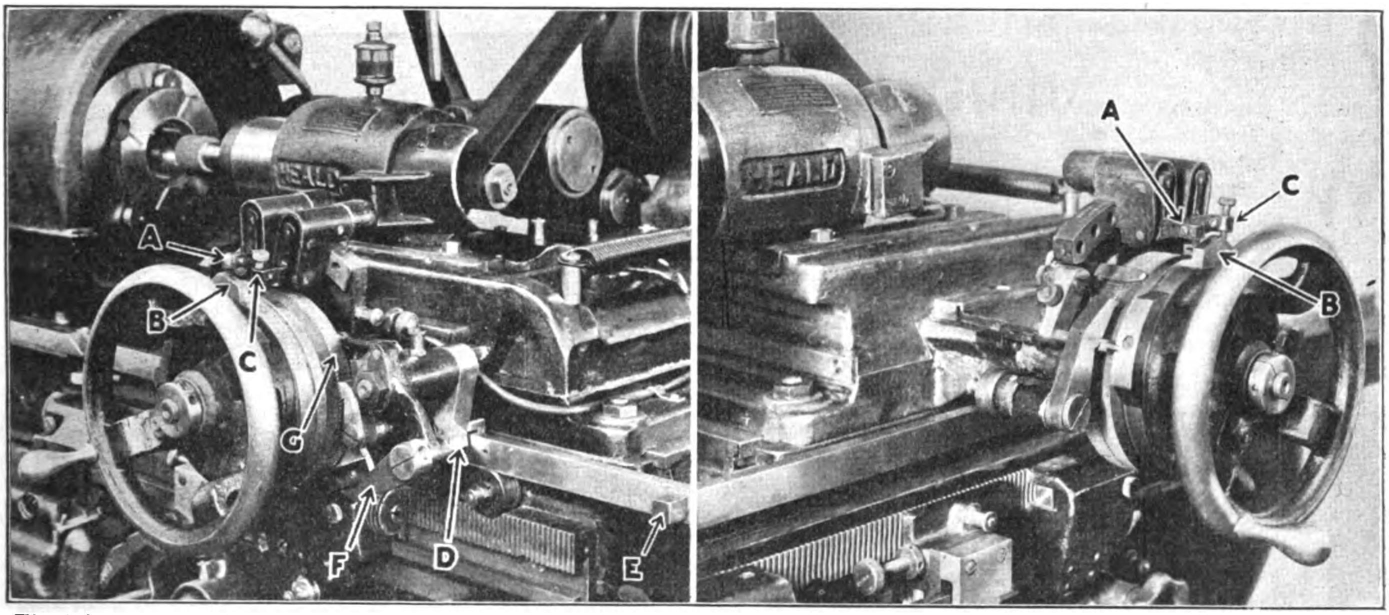
Heald Size-Matic internal grinding machine

A NEW automatic internal grinding machine known as the Size-Matic has recently been placed on the market by Heald Machine Company, Worcester, Mass. This machine is fully automatic with the exception of loading and unloading the work, and, what is most important, sizes without the use of plugs or gages. It will grind small holes, tapered holes, blind holes or holes with keyways and slots, as well as the average plain straight hole.

The cycle of operation performed automatically by the machine is as follows: After the operator has loaded the chuck, he simply throws over the reverse lever and the wheel goes up to the work at full speed, automatically slows down to roughing speed and with a roughing feed continues to grind until the hole has nearly reached the finished size. Then the head automatically withdraws from the work, the diamond drops into place, the wheel is automatically trued at a truing speed after which it again grinds, the speed having changed to a finishing speed and the feed to a finishing feed.

When the hole has reached the finished size, the wheel automatically withdraws from the work and all units go to the rest position. The operator then removes the work and the cycle of automatic operation is fully completed.

With the Size-Matic, the sizing indicator box used on the full automatic has been eliminated and an entirely new method of sizing has been incorporated, controlled by the diamond and cross slide. As shown in the close-up view of the cross slide, back of the hand wheel is an adjustable ring carrying cam *B* over which points *A* and *C* ride. These points actuate the contacts to the magnet box on the front of the machine which controls the movement of the diamond truing device and the bringing of the machine to the rest position when the piece reaches the finished size.



The left hand view shows the cam and contact points on the cross slide which control the truing and sizing; also the arrangement that compensates for wheel wear—The right hand vie w shows the pawls and arrangement on the cross slide for automatically securing the roughing and finishing feed

Point *A* when riding over the cam *B* controls the truing operation and *C* controls the finishing operation.

There is also a ratchet *G* anchored through reduction gears to the cross slide screw which is operated by the pawl *F* which itself is put in operation by pawl *D* riding over pin *E* as the main table comes out to the rest position.

Having set the diamond to true the wheel at a predetermined point in relation to the finish size of the hole, it then becomes a positive and simple matter to advance the cross slide a definite amount which is controlled by the distance between contact *A* and contact *B* to secure

exactly the same size of hole on each successive piece.

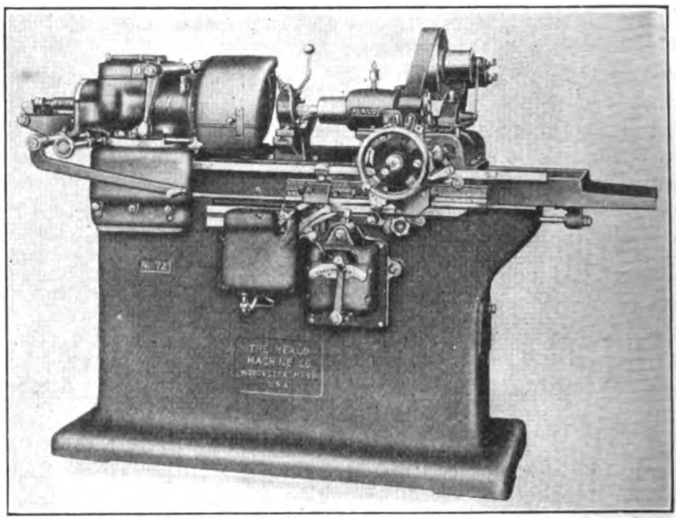
This is made possible by the fact that it is accomplished under the most ideal conditions for the wheel has just been trued, presenting a clean, sharp surface to the small, definite amount of stock to be removed. The feed is fine and the speed is correct so that with these conditions the result is an exact duplication as long as the relationship of the point of truing and the finish surface remain the same.

The cam *B* is a part of the hand wheel and assumes exactly the same position for each successive piece at the time of truing and time of finishing. Therefore, the number of passes of the wheel through the work is exactly the same on each piece and the above conditions result in continuous duplication.

There is, however, another factor to be considered and that is the wear on the wheel due to grinding and truing. If no change was made in the position of the cross slide relative to the diamond, there would be no stock on the wheel to trim after one hole had been ground and the work would not come to size. To compensate for this wear, the cross slide is automatically advanced between successive pieces as the table comes to the rest position. This, as previously described, is accomplished by pawl *D* riding over pin *E* operating pawl *F* which engages in ratchet *G*, advancing the cross slide .001 or for any amount necessary to compensate for the wheel wear.

In advancing the cross slide by this method, it does not change the relationship of the cam and the diamond so that the results are exact duplication without the use of any measuring device whatsoever.

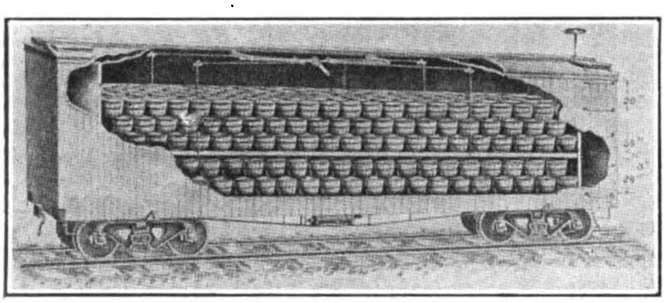
With this arrangement, where the sizing is independent of the work, it makes the machine as universal as a plain tool. In other words, with no plugs, gages or fingers touching the work the operator is able to handle a miscellaneous class of work as easily as on a plain machine and yet do it automatically. Furthermore, the setting up of the machine is a simple matter so that comparatively short runs of work can be handled advantageously in a railway shop.



The Heald Size-Matic automatic internal grinding machine

Adjustable double deck car

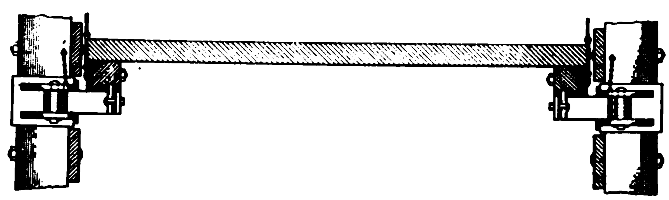
With the object of obtaining maximum loading in cars carrying fruit, vegetables, live stock and automobiles, the Shelton Adjustable Double Deck Car Company, Monadnock Building, San Francisco, Cal., have placed on the market an adjustable deck, which can be used in cars hauling the above commodities. It can be installed in refrigerator cars without interfering with the cooling equipment. The double deck is permanent in the standard type of stock car used to carry small live stock which eliminates it as a carrier for large live stock. Stock cars equipped with the adjustable double deck can be used for the transportation of large and small live stock as the deck can either be lowered to the floor or raised to the top of the car, in which positions it occupies only 4½ in. of the space in the car.



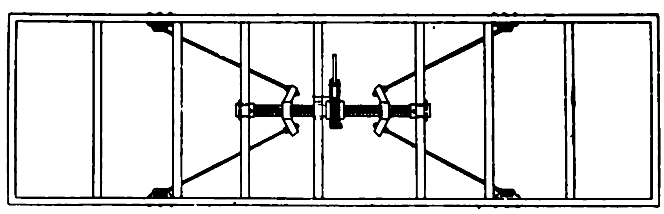
Double deck in position in a car loaded with fruit

The deck can be installed without any changes in the construction of the car. The operating mechanism does not interfere, in any way, with the utilization of the car for other purposes, nor does it have any complicated parts to get out of order. After the deck is once installed, one man can change the car in a few minutes from a single deck to a double deck, or vice versa. The deck is self-locking, assuring stability and rigidity.

The deck is supported by four wire cables which pass over four pulleys, two of which are located on each side of the car. The ends of the cables are attached to two yokes through which passes a turnbuckle screw with a right-handed thread on one end and a left-handed thread on the other end. The turnbuckle is operated by a ratchet. This lifting mechanism is shown in one of the illustrations.



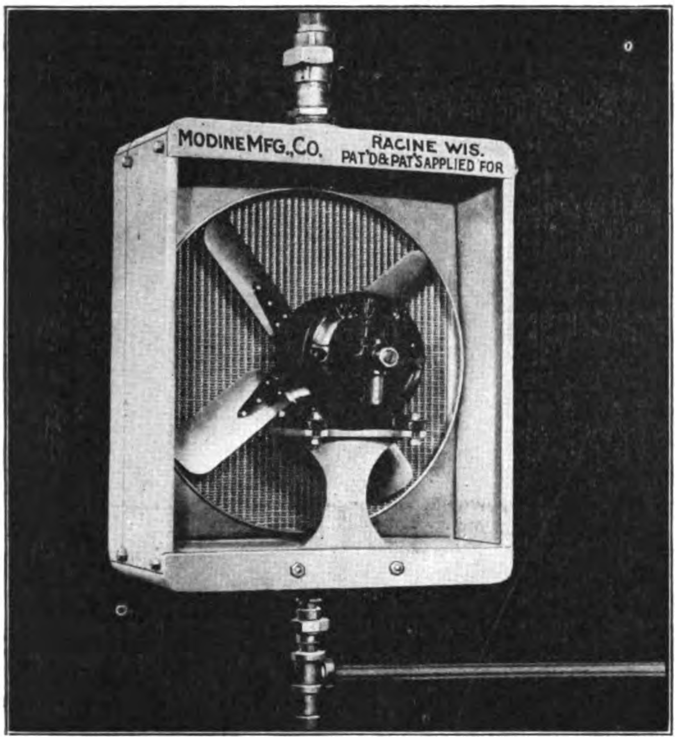
The parallel side beams of the deck rest on pins located in the end of the brackets—The brackets, when not in use swing out of the way



Top view, showing the mechanical lifting parts

Unit heater with fan

A UNIT heater equipped with a motor-driven fan which delivers air through a heating coil and distributes the heated air into the building space to be heated has been placed on the market by the Modine Manufacturing Company, Racine, Wis.



Modine unit heater which weighs only 125 lb.

It consists of three major parts; namely, the condenser assembly, the manifold and frame assembly, and the motor and fan assembly. The steam condenser is of patented construction, made by a special process from selected copper and special materials. This construction provides not only for heat transfer in accordance with the proper principles of thermodynamics, but also provides for free contraction and expansion.

The unit can be quickly taken apart. The condenser can be removed simply by taking out four bolts. The motor and fan assembly can be removed by taking out three bolts. The total light weight of the unit heater is only 125 lb. which results in two advantages. All brackets, braces and structural work are eliminated for it is only necessary to suspend the heater from the steam line by means of a length of pipe and a union. The complete unit can be turned on the union connections for direction of air flow toward the machine, bench, window, door, or wherever desired to suit the immediate heat requirements. Adjustable deflectors may be added to control the downward angle of the heat discharge.

The unit is designed to provide a maximum heat transfer with a minimum weight. The unit shown in the illustration is rated at 165,000 B.t.u. per hour, with 5 lb. steam pressure and a room temperature of 60 deg. F. In operation, the unit forces the heated upper air strata into circulation in the lower working levels and, therefore, maintains a uniform temperature without drafts or other objectionable conditions. Like practically all types of unit heaters, the Modine heater employs the heating principle of convection instead of direct radiation. Approximately 2,000 cu. ft. of air passes through the heater per minute, which is distributed over a wide area instead of being concentrated in the immediate vicinity of the heater.

Hyatt line shaft bearing

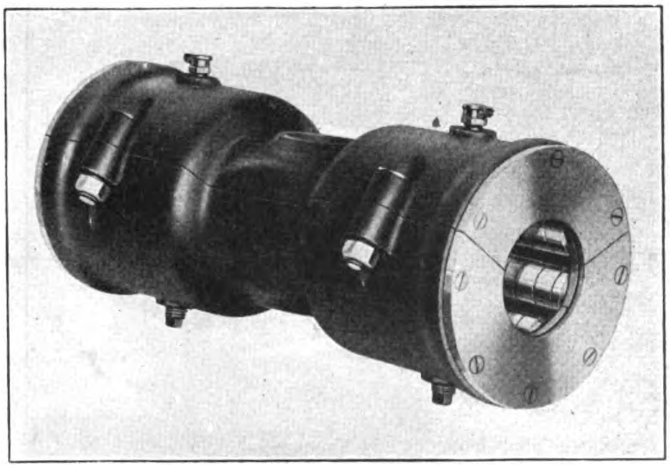
A LINE shaft roller bearing which has a narrow center and is designed to fit all makes of hangers has been placed on the market by the Hyatt Roller Bearing Company, Newark, N. J. It is completely split for easy installation. Although it differs in outward appearance from other Hyatt shaft bearings, the helically wound rollers are still employed.

The box is dumbell in shape, with the twin split roller assemblies mounted at either end. The center section, which is free from bearing surface, is reduced to average plain bearing dimensions, to fit hangers with the narrowest frame openings. The box is built in two sections, the lower part forming two-thirds, and the top, one third. This brings the machined joint well above the oil level and prevents oil leakage. Tightening four bolts seals the sections around a shaft. The bosses are staggered so that the top cannot be improperly fitted. A small wrench is the only installation tool used.

The bearing element is made up in the new series type recently adopted by Hyatt for all high-duty bearings. The bars through each roller maintain equal spacing and alinement and form a stronger cage or retainer.

It is claimed that one filling of lubricant every three or four months is the only attention that this bearing requires. Grit and other substances that tend to break down the oil film are drawn away from the bearing surface through the slots in the hollow rollers.

The bearing may be had in the following five sizes: 1 7/16 in., 1 15/16 in., 2 3/16 in., 2 7/16 in. and 2 15/16 in. For use with larger sizes of hangers requiring bearings up to 4 15/16 in. in the old line of U. G. and B. & S. type Hyatt bearings are being continued in order to have a complete line of bearings.



Hyatt line shaft bearing showing the narrow center

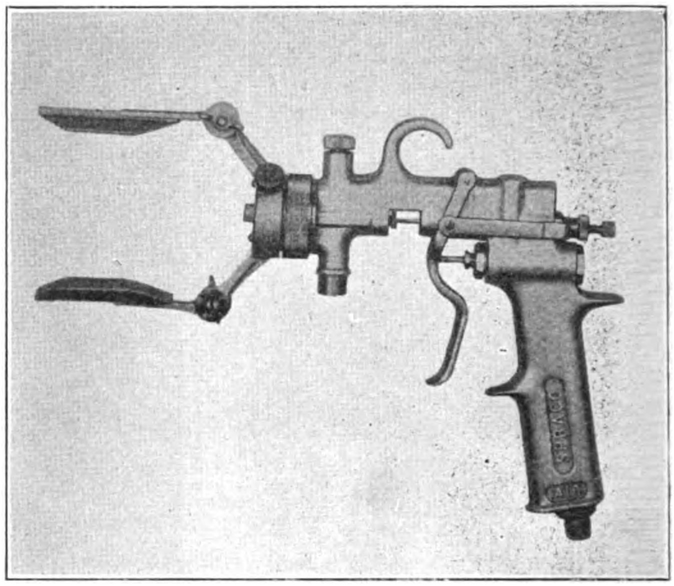
Spraco lobster claw attachment

THE lobster claw attachment for mechanical painting equipment, shown in the accompanying illustration, enables the operator to do such work as the cutting-in of trim; i.e., windows, doors, moldings, wall fixtures, and also the cutting between ceilings and walls, washboards and floors. Two color work can be completed without masking as any desired surface can be protected.

The portable paint spraying equipment consists of a portable container, of 3 to 15 gal. capacity, with a control head for the regulation of air and paint pressures, one or more paint guns, carrying the lobster claw attachment, which can be operated from one head if desired, an all-metal extension pole, air and material hose in lengths to meet all requirements, and a portable compressor and either gasoline engine or electric motor driven, with an air storage tank, gages and safety valves.

An air pressure of 40 to 55 lb. produces the best results from spraying apparatus. By means of a simple hand adjustment of air pressure, paints of different specific gravity may be applied with the same apparatus. The width of the surface covered by the spray when the gun is held 8 in. from the surface to be coated, corresponds to that covered by an 8 in. brush. It is possible to secure anything from a round, conical spray to a broad, fish-tail spray. The solids in cold water paints, bronze solutions, heavy lead paints, etc., are kept in suspension ready for application by means of either an air- or a hand-operated agitating attachment. The operator at all times has both the air and material under absolute control and can operate them at will and apply exactly the needed quantity to the surface to be covered.

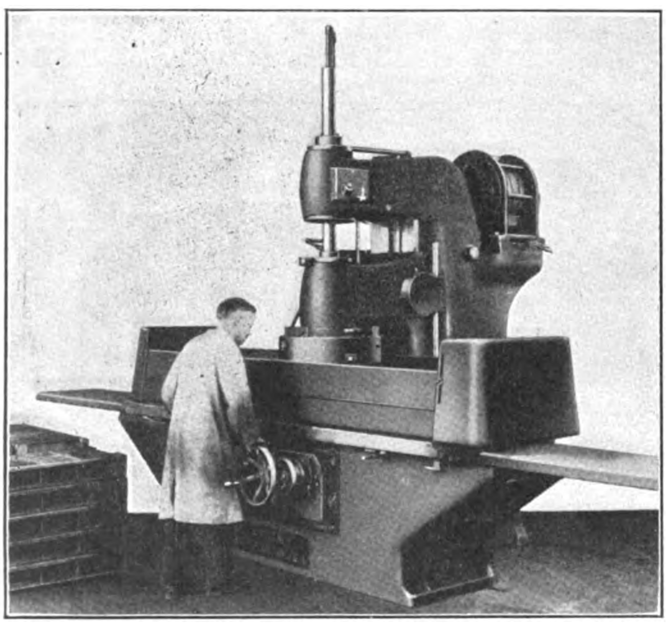
This equipment is marketed by the Spray Painting & Finishing Equipment Sales Company, 60 High street, Boston, Mass.



Lobster claws attachment for the Spraco paint spraying equipment

Improved vertical surface grinders

THE Pratt & Whitney Company, Hartford, Conn., a division of the Niles-Bement-Pond Company, New York, has placed on the market a new design of vertical surface grinders. The new machines are built in 14-in. and 22-in. sizes as were the previous models, and the 22-in machine is furnished with either 4-ft. or 7-ft. beds.



Pratt & Whitney Model B, 22-in. vertical surface grinder

The chief improvement in the new grinder is the method of driving the grinding wheel. The previous model had a belt driven spindle, using a quarter turn belt running from a driving pulley at the rear of the bed up over idlers to a large pulley on the spindle. This arrangement has been satisfactory as a smooth surface grinder drive for a number of years. It has the disadvantage of extreme belt tension, however, which has a detrimental effect on the spindle bearings, and belt maintenance costs are high.

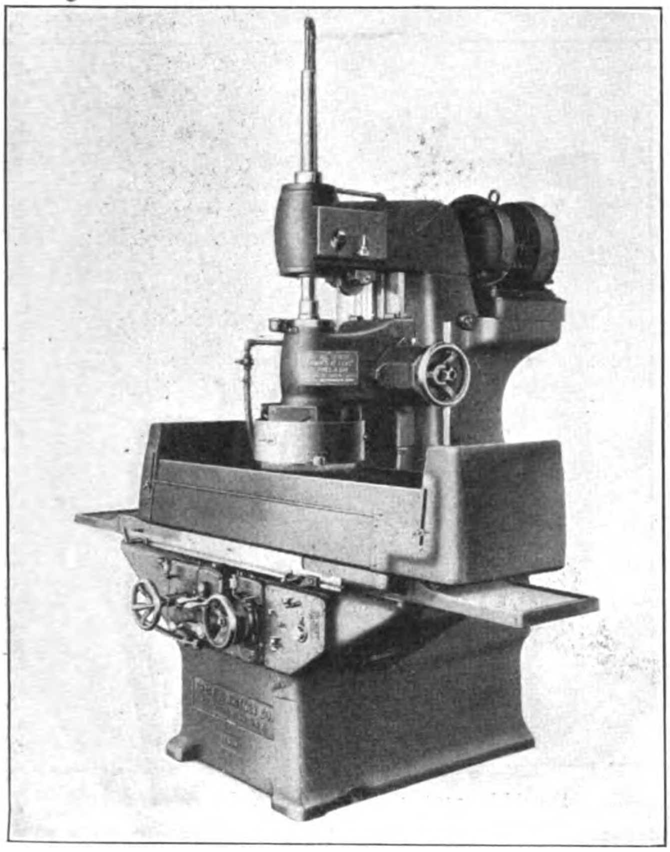
The new design of grinder is motor driven, with the motor mounted on a bracket cast in the rear of the top of the column. This motor drives the grinding wheel spindle directly through a right angle drive using circular bevel gears. The 14-in. grinder requires a 25-hp. 1750 r.p.m. motor while the 22-in. machine takes a 40-hp. 1150 r.p.m. motor. Both motors may be either a.c. or d.c.

In order to mount the motor properly the entire column has been made much heavier and more rigid. The same is true of the wheel head and spindle mounting. The direct result of this stiffening of the new Model B grinder is a much smoother and more accurate action of the machine as compared with the former type. The result of the direct connected motor is a large increase of power at the wheel, without the necessity of heavy belt tension on the spindle.

The design of the grinding wheel spindle mounting has been worked out in conjunction with the ball bearing manufacturers, and the new model is heavier and more rigid in every respect. The entire spindle is mounted on high grade ball bearings which are fully protected from dirt and moisture.

The grinding wheel is mounted on a face plate bolted to the spindle so that it can be easily removed when replacement is necessary. A sheet metal guard covers the wheel to protect the operator in case of breakage, and a wheel band is also provided for additional safety.

The wheel heads of both sizes of machine are over counterweighted for easy and rapid adjustment, and to prevent the wheel from sagging. As an additional safeguard against wheel sagging the spindle is floated on stiff springs which take up any slight wear which may occur. The grinding wheel feed controls on both sizes are essentially the same in principle but there are some variations which compensate for the difference in size. The 14-in. grinder has a handwheel at the side of the column for rapidly positioning the head. There is also a fine feed hand wheel on the front of the bed by means of which the operator can bring work down to size by hand if desired. The latter handwheel has a ratchet and pawl attachment for power feed. This is operated by the table traverse. The 22-in. grinder has both the rapid and fine feed handwheels on the front of the bed, and has the same general feed arrangement.



Model B, 14-in. vertical surface grinder

The reciprocating table is mounted on one vee and one flat way which are spaced far enough apart to provide ample support. The ways are oiled automatically by spring rollers running in oil wells. The solid top of the table protects the driving pinion and rack from grit and moisture. Guards for protecting the scraped ways on the bed are fastened to either end of the table. Tee-slots are provided for mounting magnetic chucks, work fixtures, etc.

The length of stroke and reversal of the table are regulated by dogs which are adjustable along a tee-slot in the front of the table. A safety dog prevents the table from running off the ways. The reversing gears, clutches and drive shaft are hardened and ground to secure the greatest strength and wearing qualities.

Two table speeds are provided, the operating clutch being controlled by a handle on the front of the gear box. The hand movement of the table is controlled by a large handwheed on the front of the gear-box. This handwheel may be loosened from its shaft by a convenient device so that it will not interfere with the operator when the machine is running.

A cooling solution is pumped through the hollow spindle to the wheel and is thrown between the face of the wheel and the work. In addition the solution carries away the particles of abrasive material worn off in grinding which would destroy the finish if allowed to remain. A supply of solution is also conveyed to the outside of the wheel through an adjustable pipe. The spray is confined by means of adjustable sheet metal guards.

Both sizes of the grinders are suitable for either rotary or rectangular chucks and complete chuck equipment, either plain or magnetic, is available.

The net weight of the 14-in. grinder is 8,990 lb. without the motor, and the 22-in. machine weighs 16,500 lb. and 19,250 lb. net for the 4-ft. and 7-ft. machine, respectively, without motors.

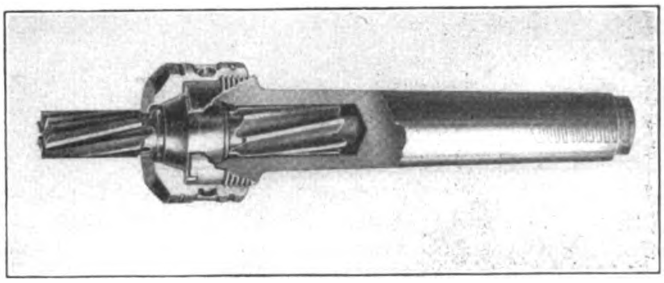
Double end mill without tapered shank

A TAPERED shank is generally used on end mills, which prohibits the use of a mill on each end of the tool. The Thurston Manufacturing Company, Providence, R. I., has placed on the market a double end mill cutter which is held in a special chuck with a lock nut. It is claimed that the mill will not turn in or pull out of the chuck. It is made in all sizes of tapered shanks and is so designed that each size taper will receive double end mills from 1/8 in. up to the capacity of the taper.

A tapered collar, one on each side of the lugs on the center of the mill, serves to center the mill and acts as a friction drive. The principal drive, however, is through the lugs which gives the tool a positive drive.

When the cutter becomes dull or breaks, it is not necessary to go to the tool room for a new one, but instead it may be removed from the chuck, turned end for end and continued the operation.

The double end mills are made in all sizes from 1/8 in. up to and including 1¼ in. diameter, both standard and two-lipped. These mills are made of high speed steel.



Assembly of the double end mill with the special Thurston chuck

Pipe and bolt threading machine

THE Chicago Pipe Thread Machinery Company, 1615 Racine street, Racine, Wisconsin, has placed on the market a new ¼ to 2 in. power pipe threading machine for production and portable use. The machine can also thread bolts ½ to 1½ in. and drive hand stocks, with the addition of a universal drive shaft; up to and including 12-in. pipe.

The machine is designed to meet all the requirements of a machine of this type and while portable it is a production and precision machine. It is motor driven with the motor direct gear connected, protected from all oil and chips; also any material being handled about the machine—there is a power extension cord with a plug to connect to any electric light socket.

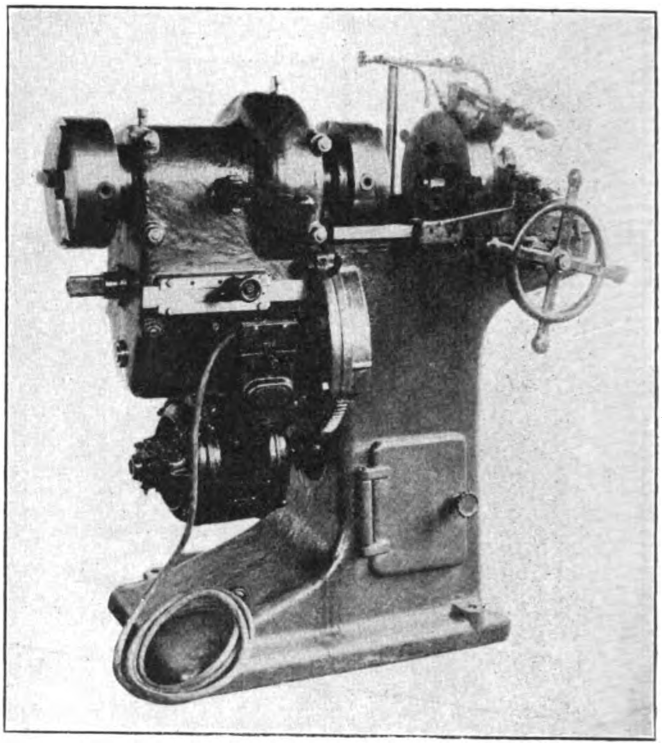
There are three speeds which most aptly cover the range of the machine and obtained through sliding gears and lever control, a clutch for starting and stopping the machine is located on the spindle giving perfect control without reference to either the motors or the gears. All gears are machine cut running in oil and the shafts are of generous dimensions running in bearings that are easily replaced.

The die thread embodies new and novel features—the life of any threading machine is determined by the wear of the die slots. The die slots in this machine when worn can be replaced with little effort and expense.

The quick opening device is most rapid and in the handle is contained the micrometer adjustment for exact, under or oversize threads, as may be required. At the rear of the die head is located the cut-off attachment which is extra heavy to withstand the most severe shocks.

The general design is modern in every respect and represents quite a departure from the conventional—it has a pedestal base in which the oil reservoir is located; also a tool and wrench cabinet for keeping dies, wrenches, etc.

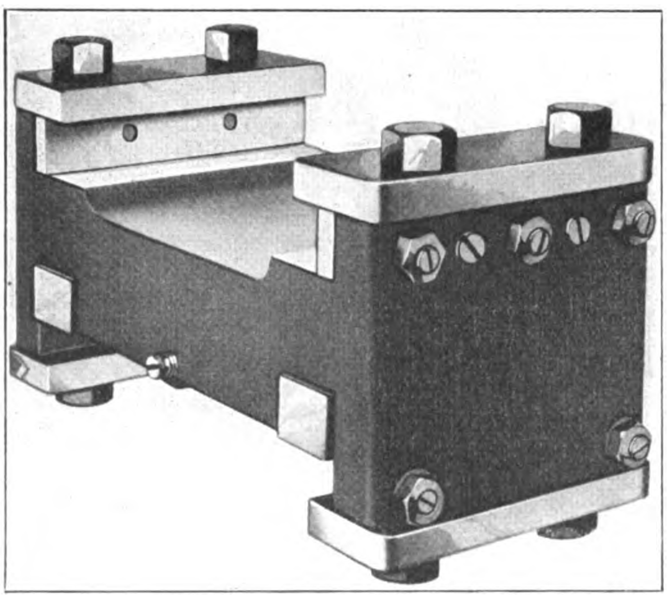
The machine is designed to be mounted on wheels when desired for portable use and it can be readily moved from place to place with little difficulty.



Portable, motor-driven pipe and bolt threader

Universal tools for turret lathes

THE Warner & Swasey Company, 5701 Carnegie Avenue, Cleveland, Ohio, has been engaged for some time in redesigning its entire line of standard turret lathe tools. Four of these new tools were described in the *Railway Mechanical Engineer* for April, page 254, and three additions to the line of tools which are now available for use with Nos. 4 and 6 turret lathes are the vertical slide tool, the turret slide support and the multiple cutter head.

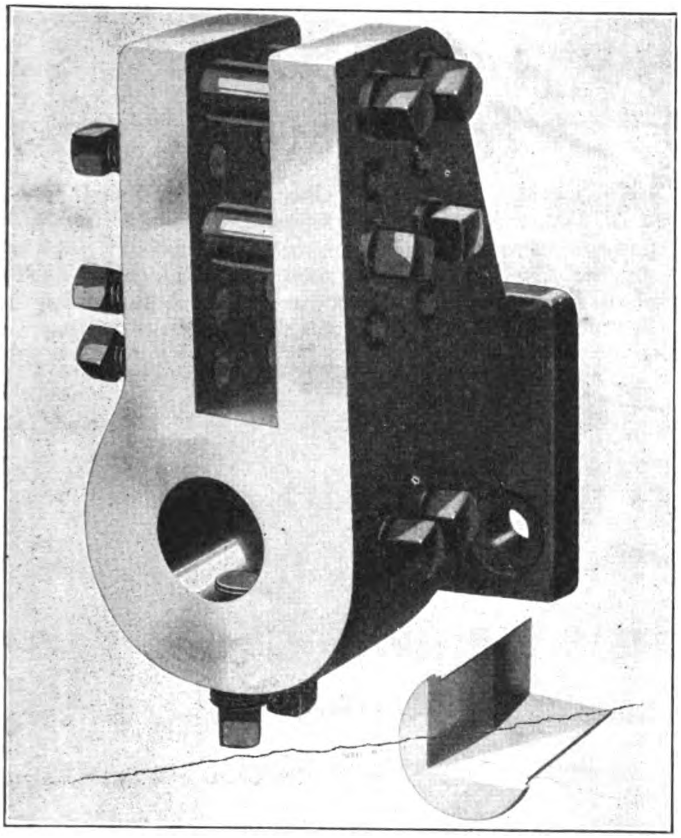


The turret slide support is useful when an extreme overhang of the tool slide is necessary

The vertical slide tool is a rigid turret tool for recessing, back facing, boring, chamfering and similar operations. The slide proper is supplied with a large micrometer dial which assures quick and accurate resetting. The micrometer dial is made very large, so that the large spaces between the graduations allow of easy and accurate resetting. Clips are provided so that they can be placed on any of these indications for resetting purposes. Forged cutters can be easily and quickly set by the use of the split bushing. The two holding set screws at right angles to each other assure proper bearing surfaces for the cutters. By removing the split bushing, boring bars can be used. The vertical slide tool itself is of strong construction and can be used for heavy cuts as well as for cuts of large diameter. A taper gib compensates for wear and increases rigidity; a binder screw rigidly clamps the slide.

The turret slide support is useful when it is necessary to have an extreme overhang of the slide, as is usually required for heavy cuts, interrupted cuts, or on long work where it is not possible to use any kind of piloting. The construction of the turret slide support is such that it is clamped on the bed between the cross slide and the turret unit. It provides extreme rigidity, allows coarser feeding and gives the turret slide additional rigidity when it

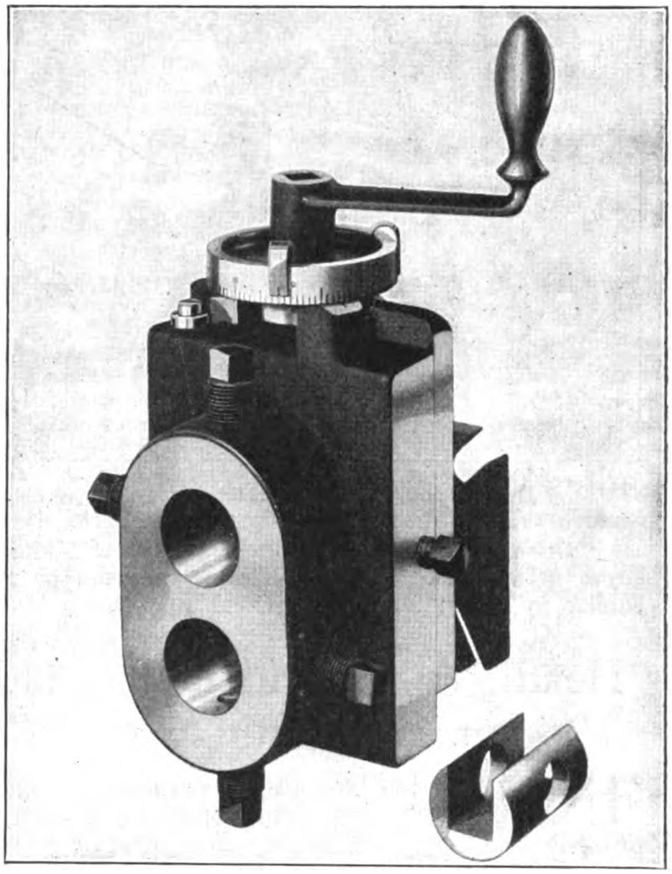
is necessary to have the slide project a considerable distance. It is provided with both vertical and horizontal adjustments which permit accurate setting in relation to the turret slide to compensate for wear. It is extremely



The vertical type multiple cutter head is used for boring, turning and facing operations

useful in conjunction with the vertical slide tool previously described when overhead piloting cannot be resorted to, and where the overhang of the turret slide is extreme, because the turret slide support gives the necessary rigidity.

The multiple cutter head is a tool for turning, facing, chamfering and boring operations at the same time that the cross slide is also cutting. The vertical construction avoids interference of the cross slide. Inexpensive forged cutters can be used, and are held in the vertical slide by the various combination of set screws so that each cutter may be set and adjusted independently of each other. The tool is made from a steel casting and is extremely rigid. A series of tie screws and bushings are provided which prevent the sides from springing apart when the forged cutters are clamped in place. These can be shifted to the various holes to allow for any number of positions that are necessary for locating the cutters. A rocker



The vertical slide tool is used for heavy, large diameter cuts

bushing provided for the center hole allows the use of square shanked forged boring cutters. The four holding set screws provided at right angles to each other provide substantial bearing surfaces for holding the cutters.

Biax flexible shaft equipment

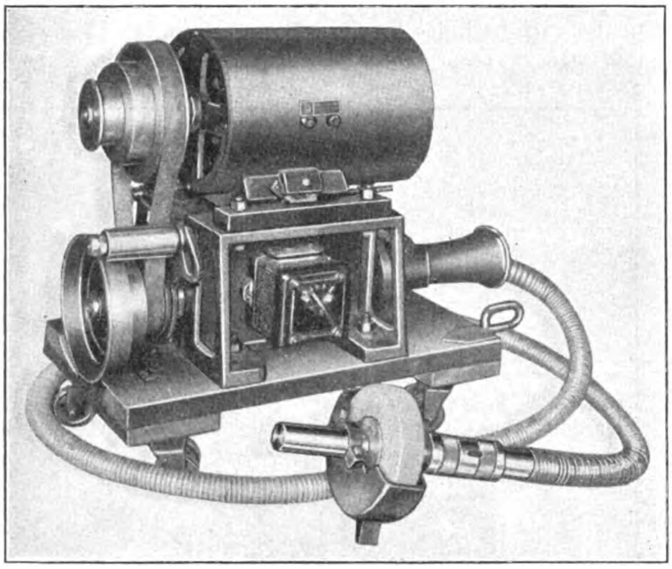
A COMPLETE line of flexible shaft equipment, which includes a variety of driving units and work attachments for all the purposes for which flexible shaft equipment can be used, is being marketed by the Biax Flexible Shaft Company, Inc., New York. The equipment can be employed for grinding, buffing, drilling, bolt setting, die sinking, scratch finishing, polishing, sanding, tube cleaning, casting cleaning and many other operations. The shafts range from .137 to 1.81 in. in diameter and can be furnished with driving units that vary in power from 1/16 to 2½ hp. and in speeds from 1,000 to 4,000 r.p.m.

The illustration shows one of the driving units attached to the shaft and the assembly fitted with one style of the many grinding attachments. In this instance the motor is mounted above the base section and the whole assembly is arranged on a portable platform. The motor can be obtained for either direct or alternating current at 110 or 220 volts, the alternating current being at 60 cycles. The drive is through a set of cone pulleys and belt with a tightener for maintaining the proper belt tension. The starting controller is mounted at the side of the base.

The flexible shaft, which is a special feature of this equipment, consists of an outer casing made of zinc plated steel and is oil tight. Inside this casing is a coil of tempered steel wire, flat in section, to provide strength and flexibility for the casing. At each end of the shaft is a reinforcement mounted outside of the casing to protect the assembly at the points where the greatest strain is imposed. The core consists of a number of coils of special cold-rolled piano wire wound in opposite directions in successive coils. The shaft

is designed to run in but one direction although it can be operated backward with a sacrifice of 20 percent of its transmitting capacity.

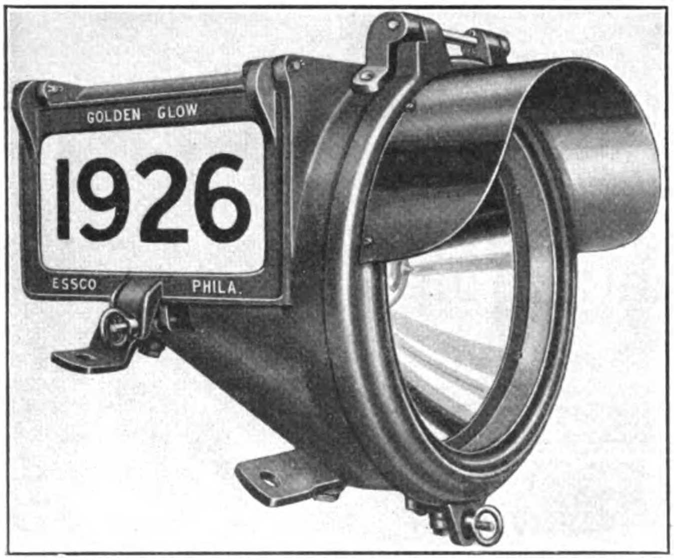
Two styles of Biax hand pieces to which the working units are attached are available. Both of these are full ball-bearing design and will run continuously without heating. One contains a clutch that is operated by sliding a sleeve in an axial direction. The second hand piece is similar in design but has no clutch and shifter collar.



Driving unit attached to shaft and grinder

Headlight for rail motor and multiple unit cars

THE Electric Service Supplies Company, Philadelphia, Pa., has placed on the market a new type of "Golden Glow" headlight with mirrored glass reflector which is especially designed for use on self-propelled rail cars, multiple unit cars and similar passenger equipment. Being designed for installation on the roof of such equipment the body of the headlight is tapered and the feet of the headlight are made so that they will conform to the curvature of the roof.

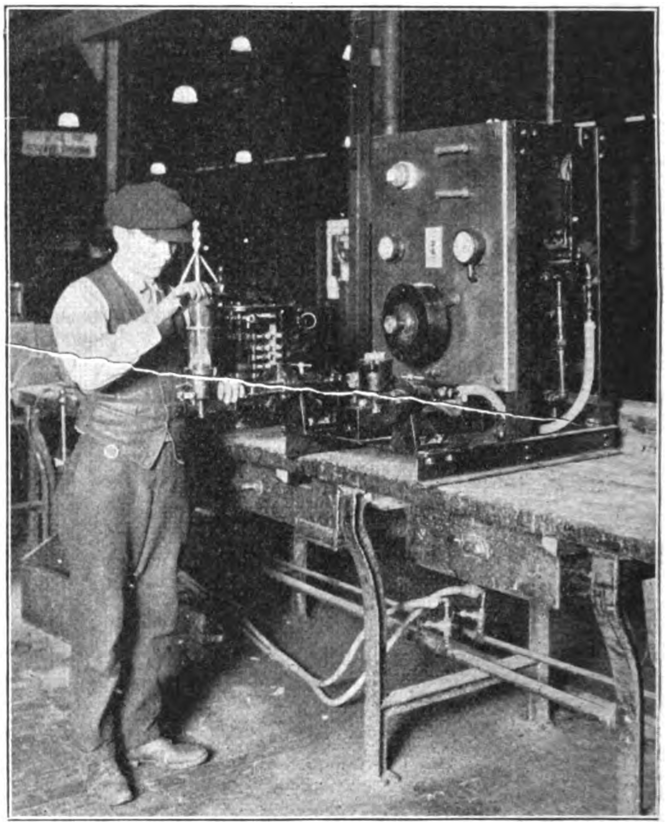


The headlight case is an aluminum casting with bronze fittings

This new headlight is known as type RA-128. The main body or case is made of one integral cast aluminum shell. Front and side doors also are aluminum and are fitted with gaskets. Fittings are of bronze.

Maintenance outfit for magnet valves

A COMPLETE outfit has been developed by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., for the thorough and systematic overhaul of electro-pneumatic valves. This equipment permits of accurate adjustments which are prime requisites to proper valve performance in their important functions in switch groups, reversers, pantagraphs, cam groups, sanders, whistles, etc.



Maintenance outfit set up with provision for working two valves at once

The outfit consists of brackets and adapters for holding the valve while it is being overhauled and undergoing tests, a rheostat for regulating the testing voltage, a testing switch, necessary indicating instruments and pneumatic equipments consisting chiefly of a reducing valve and an air reservoir.

It has been found to be of advantage to the maintenance forces not to assemble this overhauling equipment in any particular ready-to-use manner. For this reason suggestions and diagrams for arranging the outfit in bench form, accompany the equipment.

The outfit is arranged for duplicate operation, in that one valve may be tested while another is being adjusted or the valve seat ground. Provision is made for fastening the valves to the bench in such a way that they can be readily turned to any convenient working position.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

The shops of the Pennsylvania at Pitcairn, Pa., were damaged by fire on April 2, to the estimated extent of $150,000. The tin shop and the air-brake shop, with all their machinery, were destroyed, the burned-over area aggregating about 60,000 square feet.

The National Safety Council on April 6 dedicated a bronze memorial in honor of R. C. Richards, one of the founders of the safety-first movement on the railroads of America. The memorial was placed in the waiting room of the Chicago & North Western terminal at Chicago.

The Chicago, Rock Island & Pacific has contracted with the Metropolitan Life Insurance Company of New York for group life insurance for the benefit of all its officers and employees who have been in the service of the company for six months or more. About 30,000 employees are eligible.

Inspection of air brake tests

Air brake tests being conducted in the mechanical engineering building at Purdue University were inspected by the committee on safety appliances of the Mechanical Division of the American Railway Association during the week of April 5. The committee made a complete inspection of the laboratory equipment and reviewed the experimental data which has been compiled to date.

January fuel statistics

Class I railways of the United States in January consumed 9,155,429 tons of fuel coal in the operation of freight and passenger train service, at an average cost of $2.61 per ton, according to the monthly bulletin of railway fuel statistics issued by the Interstate Commerce Commission. In January, 1925, the roads used 9,209,439 tons, at an average cost of $2.81 a ton. The roads also used 180,621,590 gallons of fuel oil, at an average cost of 2.88 cents a gallon, as against 185,217,432 gallons in January, 1925, at an average cost of 2.87 cents. The total cost of coal and fuel oil in January was $29,126,599, as compared with $31,207,876 in January, 1925.

The cost of coal per net ton in January ranged from $1.75 in the Pocahontas region to $4.59 in the New England region.

Extension of time for adjustment of brake power on tank cars

Requests have been received from a number of the owners and operators of tank cars for an extension of the effective date for complying with the provisions of Circular S. III-11, issued May 15, 1919, and the Tank Car Specifications for the adjustment of brake power on existing cars, owing to the fact that so many of the cars have been scattered throughout the country making it difficult for the owners to complete the work in the time limit set, which is July 1, 1926. The General Committee has extended the effective date for complying with the requirements of the Tank Car Specifications in the matter of adjustment of brake power on existing tank cars to July 1, 1927.

A. R. A. Safety Program for June

L. G. Bentley, chairman of the committee on publicity of the Safety Section of the American Railway Association has issued circular No. 119, giving the schedule of safety activities for the month of June, as prescribed at the annual meeting; the two subjects for this month being (1) accidents due to bumping against cars which have been placed for unloading and (2) stepping or tripping on stones, boards, etc. A study of the records shows that men on repair tracks are the most common victims of carelessness under topic No. 1. Consignees and others who are in freight cars, are not properly notified by the men moving the cars. The committee thinks that a great deal of additional work should be done in connection with these two causes.

New equipment

Class I railroads during the first two months this year installed in service 12,817 freight cars, as compared with 28,120 installed during the corresponding period in 1925 and 27,729 in 1924, according to reports filed with the Car Service Division of the American Railway Association.

Of the total, 7,910 were placed in service in February, including 4,303 box cars, 2,845 coal cars and 337 refrigerator cars. Freight cars on order on March 1 totaled 50,947, including 22,140 box cars, 19,753 coal cars and 6,627 refrigerator cars. Class I railroads on March 1 last year had 50,629 freight cars on order, while on March 1, 1924, they had 45,074 freight cars on order. Class I railroads during the first two months this year also installed in service 366 locomotives, as compared with 292 installed during the same period last year and 485 during the same period in 1924. Locomotives placed in service during the month of February totaled 175. Locomotives on order on March 1 this year totaled 441, compared with 293 on the same date last year and 457 on the same date in 1924.

These figures as to freight cars and locomotives include new, rebuilt and leased equipment.

New construction

Cleveland, Cincinnati, Chicago & St. Louis.—The engine terminal to be constructed at Riverside, four miles west of Cincinnati, Ohio, at a cost of approximately $3,000,000, will consist of a 37-stall roundhouse with stalls 125 ft. long, a 100-ft. turntable and accessory buildings, water station, etc. The yard work consists of an extension and rearrangement of the present yards, and relocation of the main tracks. The material for the yard will be obtained by excavation from the engine terminal site.

Meetings and Conventions

Division VI, A. R. A., Purchases and Stores, annual meeting

The seventh annual meeting of Division VI—Purchases and Stores, of the American Railway Association, C. D. Young, chairman; W. J. Farrell (30 Church street, New York), secretary, will be held at Atlantic City, N. J., June 9, 10 and 11, 1926, with headquarters at the Chalfonte-Haddon Hall hotel. The sessions will be held in the Vernon room, Haddon Hall.

The subjects to be discussed are: Stores Department Book of Rules; Classification of Material; Recovery, Repairs and Reclamation of Discarded Material—Classification, Handling and Sale of Scrap; Provisions for Uniform Observance of General Balance Sheet Account 716—Materials and Supplies, and Recommendations Governing Charges to Material Stores Expenses, Paragraph 16—Special Instructions Operating Expenses; Forest Products; Stores Department Buildings and Facilities for Handling Materials; Workable Rules in Connection with the Carrying Out of the Provisions of Section 10 of the Clayton Anti-Trust Act; Supply Train Operation and Line Delivery of Materials; Joint Committee on Fuel Conservation; Materials Purchase Budget; Unit Piling and Numbering of Material; Purchasing Agent's Office Records and Office Organization; Stationery and Printing; General Accounting; Store Delivery of Material to Users at

Shops; Standardization and Simplification of Store Stock and Disposition of Material Reaching Obsolescence; Control of Line Stocks; Uniform Methods Pertaining to Purchases of Equipment and Large Material Contracts and Vital Statistics Relating Thereto, and Sectional Committee on Special Track Work.

Santa Fe stores officers meet

On the Sante Fe it has been the practice for a number of years for the officers of the purchasing and stores department to gather annually in a conference to discuss various problems confronting them and to promote harmony and efficiency within the department and in its dealings with other departments of the system. This year's convention was held on February 17, at San Bernardino, Cal., where extensive improvements of the store facilities have just been completed. The meeting was attended by approximately 200 delegates and visitors. Among those present during the three days' session were John Purcell, mechanical head of the system; H. S. Wall, mechanical superintendent, Coast Lines; A. G. Armstrong, superintendent of shops, San Bernardino; R. S. Belcher, manager timber treating plants system; and A. L. Conrad, assistant general auditor. H. E. Ray, general storekeeper, acted as chairman of the conference and M. J. Collins, general purchasing agent, participated in the discussions.

Safety Section at St. Louis

The Safety Section of the American Railway Association held its annual meeting at St. Louis on April 27, 28 and 29, with an attendance of about 325. At the opening session the meeting was addressed by E. A. Hadley, chief engineer of the Missouri Pacific, who appeared in place of L. W. Baldwin, president of that road, who was unable to attend. R. H. Aishton, president of the American Railway Association, made a brief address, complimenting the Section on its work. Lew R. Palmer, a director of the American Museum of Safety, presented to a representative of the Union Pacific the Harriman gold medal which has been awarded by the Museum to the Union Pacific for its outstanding safety record in the year 1925. Mr. Palmer briefly described the method by which the Museum gathers its data and the rules on which the award of the prize is based.

The election of officers of the Safety Section for the ensuing year resulted in the choice of the following:

Chairman, T. H. Carrow (Penn.); first vice-chairman, L. F. Shedd (C. R. I. & P.); second vice-chairman, P. G. Phillips (Wabash).

A. S. T. M. committees consider railroad subjects

A series of meetings was held on March 17, 18, and 19, 1926, at Providence, R. I., by a number of the committees of the American Society for Testing Materials during which a number of subjects were discussed and action taken directly concerning various departments of railroad work.

Committee A-1 on Steel, F. M. Waring, engineer of tests, Pennsylvania, Altoona, Pa., chairman, voted to refer to letter ballot of its members for adoption as tentative, new specifications for carbon steel rails which agreed with the 1925 specifications for rails of the American Railway Engineering Association with the single exception that the drop test is to be made with the head of the rail up instead of the base. Also, as a result of co-operation with the American Railway Engineering Association, new specifications are being proposed for steel tie plates and soft steel track spikes. The Sub-Committee on Steel Forgings has prepared specifications for high tensile alloy steel forgings, normalized.

Committee A-2 on Wrought Iron, the chairman of which is H. J. Force, chemist and engineer of tests, Delaware, Lackawanna & Western, Scranton, Pa., discussed new specifications for wrought iron pipe to be used for high temperatures and pressures. Arrangements have been made by this committee for conducting a series of physical tests on staybolt iron containing various percentages of phosphorus. Experiments are also being continued on both annealing and unannealing bars, including threaded specimens. All results to date indicate that wrought iron is materially improved by annealing, either in the plain bar or on the threaded bars.

Committee B-1 on Copper Wire reviewed several specifications for copper wire which covered medium hard-drawn wire and hard-drawn wire. A revision of all copper wire specifications is contemplated which will give the unit weight in terms of density rather than specific gravity. It is intended to submit these proposed specifications to the American Engineering Standards Committee, which, if adopted, will make one universal standard for the materials in question throughout the country. It was decided to specify resistivity in the specifications for bronze trolley wire in terms of lb. per mile-ohm in place of the present ohms per meter-gram. This change was made at the suggestion of the American Electric Railway Association.

Committee D-1 on Preservative Coatings for Structural Materials is considering, among a number of subjects, the accelerated weathering of paints and means of designating the color of paint materials. A method of determining elasticity or toughness of less elastic varnishes is not available. The new lacquers are also receiving the attention of this committee.

Committee D-9 on Electrical Insulating Materials has been conducting comparative tests of insulating varnishes, particularly in reference to dielectric strength tests.

Data and information relative to the work being conducted by the American Society for Testing Materials can be obtained from C. L. Warwick, secretary-treasurer, 1315 Spruce street, Philadelphia, Pa.

Fuel Association to hold convention May 11

The International Railway Fuel Association has announced its program for the eighteenth annual convention to be held at the Hotel Sherman, Chicago, May 11 to 14. C. H. Markham, president, Illinois Central, and M. L. Gould, president, National Coal Association, are scheduled for addresses at the first session on Tuesday morning, May 11. The feature of the afternoon session will be an address on Operating Factors in Fuel Conservation, by W. R. Scott, president, Southern Pacific Lines. The program for the second day includes an address on Accounting Factors in Fuel Conservation, by J. J. Ekin, comptroller, Baltimore & Ohio; an address on the Engineering Factors in Fuel Conservation, by H. R. Safford, vice-president, Missouri Pacific System, and an address by R. J. Elliott, purchasing agent, Northern Pacific. C. E. Brooks, chief of motive power, Canadian National Railways, is scheduled to make an address Thursday morning, May 13, on the Mechanical Factors in Fuel Economy. The program follows:

TUESDAY, MAY 11 (OPERATING DAY)

9:30 a.m.—(Daylight saving time.)—Addresses by J. W. Dodge, superintendent fuel conservation; Illinois Central, C. H. Markham, president; Illinois Central, and M. L. Gould, president, National Coal Association.
11:30 a.m.—Co-operation with American Railway Association—Committee report.
12:00 m.—Report of secretary-treasurer.
12:10 p.m.—Appointment of Auditing and other committees.
12:20 p.m.—Unfinished business.
12:30 p.m.—New business.
12:40 p.m.—Adjournment.
2:00 p.m.—Address on Operating Factors in Fuel Conservation, by W. R. Scott, president, Southern Pacific Lines.
2:30 p.m.—Open forum—Operating factors and fuel economy:
(a) Coal.
(b) Oil.
(c) Electric—H. S. Peck, supervisor, locomotive and power plant operation, C. M. & St. P.
4:00 p.m.—Report of Committee on Divisional Fuel Meetings.
5:00 p.m.—Adjournment.

WEDNESDAY, MAY 12 (ACCOUNTING, ENGINEERING AND PURCHASING DAY)

9:00 a.m.—Report of Committee on Fuel Accounting, Distribution and Statistics.
10:00 a.m.—Address on Accounting Factors in Fuel Conservation, by J. J. Ekin, comptroller, B. & O.
10:30 a.m.—Report of Committee on Fuel Stations.
11:30 a.m.—Address on Engineering Factors in Fuel Conservation, by H. R. Safford, vice-president, Missouri Pacific System.
12:00 m.—Open forum—Engineering factors in fuel conservation:
(a) Oil.
(b) Coal.
(c) Electricity—E. T. Howson, western editor, Railway Age.
12:30 p.m.—Adjournment.
2:00 p.m.—Report of Committee on Stationary Plants.
3:00 p.m.—Address by R. J. Elliott, purchasing agent, Northern Pacific.
3:30 p.m.—Report of Committee on Storage of Coal and Fuel Oil.
4:15 p.m.—Report of Committee on Inspection, Preparation and Analysis of Fuel.
5:00 p.m.—Open forum.
5:30 p.m.—Adjournment.

THURSDAY, MAY 13 (MECHANICAL DAY)

9:00 a.m.—Report of Committee on Diesel Locomotives.
10:15 a.m.—Address on Mechanical Factors in Fuel Economy, by C. E. Brooks, chief of motive power, Canadian National Railways.
10:45 a.m.—Report of Committee on New Locomotive Economy Devices.
(a) Coal.
(b) Oil.
Includes discussion of 1925 paper on Back Pressure as an Index to Fuel Economy, by R. W. Retterer, mechanical engineer, C. C. C. & St. L.
12:45 p.m.—Adjournment.
2:00 p.m.—Report of Committee on Firing Practice.
(a) Coal.
(b) Oil.

4:00 p.m.—Open forum—Locomotive operation and fuel economy.
5:25 p.m.—Adjournment.

FRIDAY, MAY 14

9:00 a.m.—Report of Committee on Front Ends, Grates and Ash Pans.
10:30 a.m.—Report of Committee on Constitution and By-Laws.
10:45 a.m.—Reports of Committee on Auditing, Committee on Thanks, and other special committees.
10:55 a.m.—Election of officers.
11:55 a.m.—Balloting for place of 1927 convention.
12:00 m.—Convention adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4 to 7, inclusive, Hotel Roosevelt, New Orleans, La.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting May 11. Annual meeting. Election of officers.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting May 13. Ladies' night. Special entertainment features and a ball masque.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Convention September 21, 22 and 23, Hotel Sherman, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting May 3. A paper on the reason to have all classes of cars and locomotives equipped with United States safety appliances will be presented by Henry Beriz, assistant general foreman, New York Central, Youngstown, Ohio.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting May 11. Annual banquet and entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York, May 21. Charles F. Carter will be speaker.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Texas. Next meeting May 4. Regular program.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting May 17. Annual dinner.

Supply Trade Notes

Hugh Steel, president of the Midwest Car Works, Chicago, died on April 9.

F. O Bailey, manager of sales of the Gold Car Heating & Lighting Company, New York, died at his home in Brooklyn on April 14.

The Sullivan Machinery Company, Chicago, has appointed the Borchert Ingersoll Company, St. Paul, Minn., its distributors for that state.

The Watson-Stillman Company has removed its main office and sales department from 50 Church street to 75 West street, New York City.

Avery Adams has been appointed assistant general manager of sales of the Trumbull Steel Company, Warren, Ohio, to succeed Arthur Long, resigned.

The Reading Iron Company, Reading, Pa., has appointed T. D. Graham, 850 Euclid avenue, Cleveland, Ohio, as its representative in the Cleveland territory.

Charles S. Orne, president of the Central Steel & Supply Company and purchasing agent of the Streator Car Company, died on April 10, of cerebral hemorrhage.

J. E. Murray, eastern sales manager and eastern export sales manager of the Buda Company, with headquarters at New York, has resigned to engage in other business.

Harold A. Hegeman has been elected first vice-president and treasurer of the National Railway Appliance Company, New York. Mr. Hegeman began his business career with the Ingersoll-Rand Company in its pneumatic hammer department. He left the shop to enter its selling organization and then went to the shops of the New York & Queens County Railway to learn the practical side of electric railroad methods. After serving in the mechanical department and the maintenance-of-way department, he went with the United States Metal & Manufacturing Company as a salesman, and after the liquidation of that company and its railroad interests had been succeeded by the National Railway Appliance Company, he served with the latter company as vice-president and treasurer. He has held this position for the past nine years.

Harold A. Hegeman

Newton E. Dabolt, who for the past six years has been general sales manager in charge of sales for both the lacquer and leather cloth divisions of the Zapon Company, has resigned.

The Milwaukee Crane & Manufacturing Corporation, Milwaukee, Wis., has opened an office in Chicago in charge of Byron B. Evans, formerly district representative at Pittsburgh, Pa.

John W. Guay, sales engineer of the Fort Pitt Steel Casting Company, has been appointed works manager, and H. F. Stratton, formerly in charge of the pattern, mold and core department, is now superintendent.

The Kalamazoo Railway Supply Company, Kalamazoo, Mich., has opened an office at 50 Church street, New York, in charge of J. E. Murray and H. M. Clawson, who will conduct its Eastern domestic and export sales.

J. Reis, vice-president of the United States Steel Corporation at New York, has resigned and will retire from active business. Mr.

Reis was vice-president of the steel corporation from 1911, and previously was assistant to the president.

R. H. Sonnborn has been appointed district manager of the Youngstown Sheet & Tube Company, with headquarters at Detroit, Mich. R. J. Mullaly, formerly superintendent, has been appointed representative, with headquarters at Detroit.

Albert Roberts, formerly sales and service engineer of the Grip Nut Company, Chicago, has been appointed district manager of the southern territory of the Duff Manufacturing Company, with headquarters in the Candler building, Atlanta, Ga.

The Ohio Injector Company, Wadsworth, Ohio, has opened sales offices in Tulsa, Okla., and Ft. Worth, Tex., in charge of V. H. Morgenstern and C. H. Brown, who were formerly associated with the Continental Supply Company, St. Louis, Mo.

Joseph T. Ryerson & Son, Inc., Chicago, has completed arrangements with F. A. Brandes, of the Brandes Machinery Company, Keith building, Cleveland, Ohio, to represent them exclusively for this company's line of metal working machinery and small tools.

George T. Ramsey has been appointed railroad department representative, in the East, of the United Alloy Steel Corporation, Canton, Ohio. Mr. Ramsey will have his headquarters at the company's office in the Pershing Square building, New York City.

C. C. Fredericks, formerly associated with S. F. Bowser & Co., Inc., Ft. Wayne, Ind., has been elected president and general manager of the St. Louis Pump & Equipment Company, St. Louis, Mo. Sherwood Hinds has been elected chief engineer and vice-president.

The Foster Bolt & Nut Manufacturing Company, Cleveland, Ohio, will construct an addition to its plant at Cleveland, following the completion of the addition which it is now constructing. This company has also just placed in operation a new plant at Chicago.

Frank W. Edmunds, president of Craft, Inc., 441 Lexington avenue, New York, has been appointed general eastern sales manager of the Boss Bolt and Nut Works division of the Hoopes & Townsend Corporation, Chicago. Mr. Edmunds began his business career an an office boy, serving, first with John A. Griswold, president of John A. Griswold & Co., who built the Monitor that during the Civil war completely revolutionized the construction of battleships. That company later became the Troy Steel Company and so operated until it liquidated years later. In the meantime, Mr. Edmunds had been promoted to the position of secretary-treasurer and general sales manager. He then became identified with the Q & C company at Chicago as secretary, acting also as western representative of the Pennsylvania Steel Company. Later he became associated with the Dressel Railway Lamp Works of New York, which association he retained for fifteen consecutive years. In June, 1918, he resigned as sales manager of the Dressel Company to become eastern sales manager of the Sunbeam Electric Manufacturing Company, from which position he retired December 31, 1924. Mr. Edmunds served for years on various committees of the Railway Supply Manufacturers' Association and other manufacturing associations connected with the railway supply industry and is now secretary-treasurer of the Signal Appliance Association and secretary of the American Brake Beam Export Association.

F. W. Edmunds

Howard B. Jernee has been appointed sales manager of the line shaft bearing department of the Hyatt Roller Bearing Company, Newark, N. J., succeeding Frank S. Cole. Mr. Jernee was formerly construction engineer for E. I. du Pont de Nemours & Co., and later, works engineer at the Oakland Motor Car Company plant, Pontiac, Mich.

Jos. T. Ryerson & Son, Inc., New York, has taken over the reinforcing bar division of the Penn Metal Company, of Boston, Mass., and will immediately add to the bar sizes and tonnage carried. General sales offices have been opened at 677 Concord avenue, Cambridge, Mass.

The Oliver Electric & Manufacturing Company, St. Louis, Mo., has been merged with the Pyle-National Company, Chicago, the personnel of the Oliver Electric & Manufacturing Company retaining its identity with the Pyle-National Company. The offices of the Oliver Electric Company have been moved to 1334 North Kostner avenue, Chicago.

Andrew C. Loudon, vice-president of the Superheater Company, Ltd., of Montreal, Quebec, died on April 11 of pneumonia, at his home in Burlington. Vt Mr. Loudon was born at Valley Field, Quebec, on July 7, 1883, and received the degree of B. S. from McGill University in 1906. He took an apprenticeship course with the Canadian Pacific at Montreal, Quebec, and the Grand Trunk at Portland, Me., during 1901 and 1902, and from 1906 to 1907 was in the calculating department of the American Locomotive Company. In 1907 he was appointed enginehouse foreman of the Grand Trunk at Island Point, Vt., and from January to December, 1909, served as machinist and draftsman of the Central Vermont and the Delaware & Hudson at Green Island, N. Y. He then entered the test department of the Atchison, Topeka & Santa Fe, and in 1910 went with the Grand Trunk Pacific, where he served consecutively as construction foreman and foreman of locomotive and car repairs. In 1912 he entered the service of Simmons-Boardman Publishing Company as assistant editor of the Car Builders' Dictionary & Cyclopedia, and later served as associate editor of the Railway Age Gazette, also as associate editor and then as managing editor of the American Engineer and Railroad Journal (now the *Railway Mechanical Engineer*). In 1917 he joined the staff of the Superheater Company, New York, and, in January, 1921, was appointed vice-president of the Superheater Company, Ltd., of Montreal, Quebec. Mr. Loudon was a member of the Engineering Institute of Canada; the American Society of Mechanical Engineers; the Engineers' Club of Montreal, and a number of other social and fraternal organizations.

Andrew C. Loudon

The Midwest Railway Equipment Company, McCormick building, Chicago, has been organized by A. P. Sweeney, formerly assistant to the secretary of the Mechanical Division of the American Railway Association, and L. J. Brown, formerly vice-president of the Illinois Railway Equipment Company, Chicago, to engage in the sale of railway supplies.

Fred A. Poor, president of the P. & M. Company, Chicago, has been elected chairman of the board of directors. P. W. Moore, vice-president, has been elected president, succeeding Mr. Poor. F. A. Preston, vice-president of the P. & M. Company, has been elected also president of the Maintenance Equipment Company, Chicago, succeeding Mr. Poor.

Ross F. Hayes, railway supplies, has removed his office from 2 Rector street to 30 Church street, New York. Mr. Hayes represents the Henry Giessel Company; the railway department at Newburgh, N. Y., of E. I. du Pont de Nemours & Co., Inc.; the D. P. Company, maker of steel dust guards, and the Protecto Manufacturing Company, maker of weather-stripping.

W. E. Frasier, Jr., will work as railroad sales engineer for S. F. Bowser & Co., Inc., Fort Wayne, Ind. Mr. Frasier will have his headquarters at the New York office, 19 West Forty-fourth street. He was formerly employed by the Ellcon Company, New York City, and prior to his employment with the Ellcon Company he was with the Valentine Company.

Harlan A. Pratt has been appointed manager of the oil and gas engine department of the Ingersoll-Rand Company, New York. Mr. Pratt formerly served in the sales department of the Westinghouse Electric & Manufacturing Company, later becoming sales manager of the Atlantic Elevator Company, agents in the east for Westinghouse Gearless Traction Elevators. For the past three years he has been sales manager of the Elevator Supplies Company, Hoboken, N. J.

Clarence Price, formerly with the American Car & Foundry Company as sales agent and later as vice-president, from 1903 until his retirement in 1916, died at his home in New York on April 2. Mr. Price was born on July 28, 1862, in Cincinnati, Ohio, and graduated from Princeton University in 1885. He entered railway service in January, 1900, as purchasing agent of the Chicago & Alton, leaving that position in March, 1903, to go with the American Car & Foundry Company.

L. E. W. Bailey, who for some years past has been railroad sales manager for the Dearborn Chemical Company, Ltd., at Toronto, Canada, has joined the Superheater Company, Ltd., of Montreal, as service engineer. Previous to his connection with the Dearborn company, Mr. Bailey served with the Canadian Pacific and the Great Northern railways, having worked his way up in the motive power department from fireman and engineman to division master mechanic.

Charles Leonard Rowland, engineer, of Carbondale, Pa., died on April 19 at the Post Graduate Hospital, New York. Mr. Rowland was born in Brooklyn, N. Y., on November 28, 1852. He began his career with the Morton Iron Works, Brooklyn. In 1908 he founded the American Welding Company of Carbondale, of which he was president until last February, when the company was merged with the American Car & Foundry Company. During the World War, Mr. Rowland invented a one-ton container for transporting chlorine gas overseas.

Albert Roberts has been appointed district manager of the southern territory of the Duff Manufacturing Company, Pittsburgh, Pa., with office in the Candler building, Atlanta, Ga. Mr. Roberts was formerly associated with the Grip Nut Company, Chicago, Ill., having served in the capacity of sales and service engineer in the southern territory over a period of the last twelve years. Prior to this, he was connected with the mechanical department of the Nashville, Chattanooga & St. Louis. George E. Watts has been appointed special representative of the Duff Manufacturing Company in the southern district, with headquarters as heretofore in the company's office, Candler building, Atlanta.

A new company to be known as Hall-Will, Inc., has been incorporated under the laws of Pennsylvania to manufacture a modern line of pipe, bolt and nipple threading machinery at Pearl and Wagner avenues, Erie, Pa. Leslie Hall, formerly vice-president and general manager of the Williams Tool Corporation, has been elected president of the new company; C. F. Williams, formerly general superintendent of the Williams Tool Corporation and more recently associated with the Erie Steam Shovel Company, which connection he will still continue to hold, has been elected vice-president, and Harry W. Sims has been appointed secretary and treasurer. The directors of the company are G. C. Hay, formerly sales manager of the Williams Tool Corporation; J. W. McLeod, C. A. Rice, and J. H. Sternberger. Mr. Hay also will be sales manager of the new company, and Mr. McLeod, works manager.

The Gould Car Lighting Corporation, a subsidiary of the Gould Coupler Company of Depew, N. Y., has been organized recently in Maryland to take over the car lighting business of the parent company. The new company has bought the plant and equipment of the Lexington Machine Corporation of Rochester, N. Y., which was built originally for the manufacture of automobile and marine engines, and is well adapted for the manufacture of car lighting generators and auxiliary equipment. The officers of the new company are: W. S. Gould, New York, president; J. A. Saur, New York, and Donald S. Barrows, Rochester, vice-presidents; P. P. Meade, Rochester, treasurer, and Bickett Nairn, who was president of the Lexington Company, is secretary and assistant treasurer of the Gould Car Lighting Corporation. W. F. Bouche, at present superintendent of the car lighting department of the Gould Coupler Company at Depew, will be manager of the new corporation, with headquarters at Rochester.

Trade Publications

FLOODLIGHT PROJECTORS.—Bulletin No. 2083, descriptive of short range Imperial floodlight projectors, has been issued by the Crouse-Hinds Company, Syracuse, N. Y.

OKONITE PRODUCTS.—Several four-page folders, descriptive of Okonite tapes, Okocord portable cords and Okonite cement, have been issued by the Okonite Company, Passaic, N. J.

PUMPS AND AIR COMPRESSORS.—Bulletins Nos. 207 and 127, descriptive of multi-stage centrifugal pumps and direct-connected synchronous motor-driven air compressors, respectively, have been issued by the Pennsylvania Pump and Compressor Company, Easton, Pa.

REFRACTORY GUN.—The use of the Quigley refractory gun for the quick repair and maintenance of furnace linings, including hot patching and surface coating, is described in a 14-page illustrated booklet issued by the Quigley Furnace Specialties Company, 26 Cortlandt street, New York.

WATER METERS.—The value of the water meter for distribution lines, pump operation, filtration plants, hydro-electric plants, etc., is discussed in a 16-page bulletin, No. W-31, descriptive of Republic water meters, which has been issued by the Republic Flow Meters Company, 2240 Diversey Parkway, Chicago.

CERTIFIED MALLEABLE IRON.—Bulletins Nos. 50, 51, 52 and 53, the first four of a series of industrial bulletins, containing pertinent facts about certified malleable iron which every user of metals should know, are being distributed by the American Malleable Castings Association, Union Trust building, Cleveland, Ohio.

PNEUMATIC TOOLS.—Catalogue No. 15, descriptive of Thor pneumatic tools, including accessories, busters, drills, grinders, hammers, hoists, holders-on, etc., has been issued by the Independent Pneumatic Tool Company, 600 West Jackson boulevard, Chicago, Ill. Instructions for the maintenance and ordering of pneumatic tools and their weights and dimensions packed for export are given in the catalogue, also illustrations showing the use of the tools in building cars and locomotives, in building ships, in boiler shops, foundries, machine shops and steel mills, etc.

PAINT PIGMENT.—A 26-page research bulletin descriptive of metallic zinc powder as a paint pigment has been issued by the New Jersey Zinc Company, 160 Front street, New York. Metallic zinc powder, also known as Zinc dust, is not a by-product made in the smelting of zinc ores, but is distilled in furnaces especially designed and operated for its sole production. The primary purpose of the bulletin is to present the practical information and formulas already obtained by test so that known and tried paints may be made up by those interested and further experiments inaugurated.

THREAD STANDARDIZATION.—In co-operation with the Department of Commerce, Division of Simplified Practice, and the National Thread Commission, appointed by Congress, the Eastern Machine Screw Corporation, New Haven, Conn., has compiled tables listing those thread sizes considered standard and for which chasers are stockable, and is distributing them in folder form for purchasing departments, engineering departments, stores departments, etc. A new catalogue of H. & G. self-opening die heads has also been issued by the Eastern Machine Screw Corporation, in the appendix of which a number of pages from the report of the National Thread Commission have been reprinted.

CHUCK WORK.—This is the second of a series of booklets being prepared by the Warner & Swasey Company, Cleveland, Ohio, on modern tooling methods for turret lathes. The problems of chucking work are discussed in much the same manner that the problems of bar work were treated in a previous booklet. The design, selection and use of Universal chucking tools is fully covered and chapters are devoted to the practical application of these tools to typical chucking set-ups and a discussion of the operations involved. The third booklet of the series will also deal with chuck work. Further examples of chuck tooling will be given and the individual tools will be described in greater detail.

Personal Mention

General

Irving C. Blodgett has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., succeeding Frank H. Becherer, resigned.

L. A. Richardson has been promoted to general superintendent of motive power of the Chicago, Rock Island & Pacific, with headquarters at Chicago, succeeding W. J. Tollerton, deceased. Mr. Richardson was born at Bucklin, Mo., in 1868, and entered railway service in 1884 as a machinist apprentice on the Union Pacific at St. Joseph, Mo., later being promoted to roundhouse foreman and then to general foreman at the same place. After being transferred to the Oregon Short Line for a short time he entered the service of the Rock Island in 1906 as master mechanic, with headquarters at Trenton, Mo. Mr. Richardson was transferred to Chicago in 1910, where he remained until 1913, when he was promoted to mechanical superintendent, with headquarters at El Reno, Okla. He was transferred to the First district, with headquarters at Des Moines, Ia., in 1916, later being promoted to superintendent of motive power, with the same headquarters. He continued in that capacity until his recent promotion to general superintendent of motive power.

L. A. Richardson

T. W. McCarthy has been promoted to superintendent of motive power of the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, succeeding L. A. Richardson. Mr. McCarthy was born on April 27, 1862, at Dunkirk, N. Y., and entered railway service about 1883 in the mechanical department of the Union Pacific. Previously he had served an apprenticeship with the Brooks Locomotive Works and the Dunkirk Engineering Works. Beginning railway service, he was employed as a machinist, later being promoted to gang foreman, night roundhouse foreman and general foreman. After several years' service with the Wheeling & Lake Erie and the Wabash, he was appointed general foreman on the Chicago, Rock Island & Pacific at Shawnee, Okla., in 1906. He was later promoted to master mechanic of the Arkansas division, being transferred later to the Panhandle-Indian Territory division, and still later to the Kansas division. In September, 1923, he was transferred to the Cedar Rapids-Minnesota division, with headquarters at Cedar Rapids, Iowa, where he remained until his recent promotion to superintendent of motive power.

T. W. McCarthy

W. H. Fetner, chief mechanical officer of the Missouri Pacific, with headquarters at St. Louis, Mo., has been appointed also chief mechanical officer of the Gulf Coast Lines and the International-Great Northern.

F. G. Lister, master car repairer of the Southern Pacific, with headquarters at El Paso, Tex., has been appointed chief mechanical engineer of the St. Louis-San Francisco, with headquarters at Springfield, Mo., to succeed A. H. Oelkers, resigned.

Master Mechanics and Road Foremen

F. M. Clark has been appointed road foreman of engines of the Charlotte Harbor & Northern, with headquarters at Arcadia, Fla.

G. E. Sisco has been appointed assistant master mechanic of the Fort Wayne division of the Pennsylvania, with headquarters at Fort Wayne, Ind.

B. H. Smith, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, has been transferred to Horton, Kan., succeeding G. W. Cuyler.

G. W. Cuyler, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Horton, Kan., has been transferred to Des Moines, Iowa, succeeding T. W. McCarthy.

E. L. Bachman, assistant master mechanic of the Panhandle division of the Pennsylvania with headquarters at Cully, Pa., has been promoted to master mechanic of the Wheeling division, with headquarters at Mingo Junction, Ohio.

Car Department

George Oliver, for the past eight years chief clerk to the master car builder of the Belt Railway of Chicago, has been appointed general car foreman of the Fort Street Union Depot Company, with headquarters at Detroit, Mich.

Frank H. Becherer has resigned as assistant to the mechanical superintendent of the Boston & Maine to become superintendent of the car department of the Central of New Jersey. A sketch of Mr. Becherer's railroad career appeared in August, 1925, issue of the *Railway Mechanical Engineer,* page 537.

Shop and Enginehouse

Frederic E. Lyford, supervisor of apprentices of the Lehigh Valley at Sayre, Pa., has been promoted to assistant general machine shop foreman, with headquarters at Sayre.

W. P. Bickley, machine shop foreman of the Buffalo division of the Pennsylvania, has been appointed general foreman, locomotive repair shop, Eastern division, with headquarters at Canton, Ohio.

Purchases and Stores

Lee F. Blood has been appointed purchasing agent of the Green Bay & Western, succeeding H. E. Dutton, deceased.

Thurman A. Stinson has been appointed storekeeper of the Green Bay & Western, succeeding E. C. Juley, deceased.

W. F. Vogt has been transferred from Altoona, Pa., to Philadelphia as assistant general storekeeper of the Pennsylvania.

O. V. Daniels, assistant general storekeeper of the Pennsylvania, at Philadelphia, Pa., has been appointed general storekeeper, with headquarters at Altoona, Pa., succeeding W. F. Vogt.

E. T. Campbell and E. Curtis have been appointed division storekeepers on the Chesapeake & Ohio, with headquarters respectively at Russell, Ky., and Ashland, Ky. R. H. Rutman has been appointed assistant division storekeeper, with headquarters at Russell.

J. L. Cowan, tie and timber agent of the Southern Pacific lines in Texas and Louisiana, and formerly purchasing agent of the San Antonio & Aransas Pass, has been promoted to assistant purchasing agent of the lines in Texas and Louisiana, with headquarters at Houston, Tex.

Obituary

Ernest C. Juley, general storekeeper of the Green Bay & Western, died on March 5, after a short illness.

Railway Mechanical Engineer

Vol. 100 June, 1926 No. 6

Study the problem as a whole

The demand for increased output from modern locomotive repair shops has brought about many changes in organization—both from the standpoint of men and methods. There is a difference of opinion among mechanical department officers as to just what extent the repair forces and facilities at engine terminals should assist in maintaining motive power. One group advocates making all classified repairs in the main shops and, in addition, handling as great an amount of heavy running repairs as possible so that, in effect, the engine terminals are required to make only such repairs as are required to keep the locomotives in condition for road service. This has the effect of making it possible to limit the forces and facilities at certain engine terminals. In direct contrast with this, another group advocates the handling of even the heavier running repairs and in some cases light classified repairs in shops located at engine terminals so that only the heavier classified repairs are handled in the main shops.

It is doubtful whether it is possible to say that one plan is better than the other—the chances being that a great deal will depend upon conditions existing on individual roads. There is one factor, however, that exists in both cases that is extremely important and that is the effect of handling enginehouse work in connection with the regular run of repair work in the back shop. Many shop supervisors who have been able to work out effective shop scheduling systems have found it difficult to know how to balance the work in locomotive shop sub-departments in such a manner that emergency enginehouse work will not interfere with the effectiveness of the scheduling system. The handling of work for the enginehouse in the back shop would not in many cases have such a disastrous effect on the regular shop work were it not for the element of uncertainty. This work does not come to the shop in a steady volume nor is it of such a nature that it can be handled in a routine manner.

Locomotive shop output has ceased to be purely a departmental problem. While in most cases, up to the present time, the particular manner in which the work is handled in any particular shop is left to the ingenuity and initiative of local shop supervisors, it very often proves the case, after costly experiments in organization, that the effectiveness of the shop as a unit in the whole maintenance of equipment scheme can be enhanced by developing a shop system which fits in with the general method of handling locomotive repairs on the entire road. Such being the case, general mechanical department officers must, sooner or later, take an active personal interest in the detailed methods used to promote shop efficiency and it may be discovered in many cases that they alone have the necessary authority to make the kind of changes which will enable the back shop to function with greater effectiveness.

Abuse of the drilling machine

The possibilities of the drilling machine as a general purpose tool in the railroad shop are pointed out in an article in this issue. A machine in this service is in danger of excessive abuse which can be avoided if thought is given to its operation. A drilling machine is a carefully constructed and accurate tool and should be treated as such. Regardless of how massive a machine may be constructed or of the driving power conveyed to the spindle or feed mechanisms, the machine may be unduly strained and abused. Drill spindles should at no time project further from their housings than is actually required for the work. This point seems to be generally disregarded not only in railway shops, but in all shops where drill presses are used. Non-observance of this rule frequently results in sprung or bent drill spindles.

The new machine must be lubricated frequently and should be given light service until all bearings are thoroughly worn in. Good judgment in the earlier stages of usage of a drill press will prolong the service life. Collets or tool shanks must fit the drill spindle accurately. No other condition should be permitted. Heavy work should not project beyond the table without suitable outward support. Otherwise, deflection or spring of the machine will result. The drill table is intended as a support for the work, not as a bench block. Rough usage will cause the table to be bowed or arched. Accurate work cannot be produced on it in this condition.

Possibly no more severe strains can be imposed on a drilling machine than that occasioned by forcing a dull drill into the work or by the continuation of the feed pressure after the drill has ceased to revolve. A skilled operator will know by the "feel" of the drill when fed into the work by hand whether the tool is or is not cutting properly. This is particularly true of large drills. Insufficient clearance will set up excessive stresses in the column of the machine. For this reason it is good practice to feed a drill into the work by hand until it is cutting to the full diameter of the hole. Lack of clearance will readily be detected if the operator follows out this practice.

The twist drill is the object of more abuse than any other tool. It has been found that most of the complaints relative to the improper working of drills, can be traced to imperfections in the machines rather than in the drills. These imperfections are in the nature of lack of rigidity, usually on account of the machine being used beyond its capacity, or the machine is not sensitive enough to care properly for the lighter work of small drills. In the first case, spindle vibrations are set up, causing chatter at the point of the drill. This is apt to cause a chipping off of the cutting edges of the drill which quickly leads to failure. In the second case, it is found that the work is apt to be done on machines which are too heavy and

which lack the proper speeds and balance for the successful operation of the drill.

The upkeep or repair of the machine is of vital importance to the success or failure of the drill. Attention to the spindle bearings, particularly the thrust, is essential. If the thrust bearings are worn there results a back-lash. This is a dangerous feature since there is considerable point pressure on a drill on its way into the work and when the drill is breaking through there is apt to be a sudden release from the thrust, causing the drill to shoot ahead of the natural feed. When this happens, the drill bites into the remaining undrilled portion, causing an undue stress on the drill with resultant breakage.

It is often noted that the taper holes in the spindle ends and in the sleeves, sockets or adapters are worn until the taper is not true, and the drill shank which, when it is new is of accurate taper and correct dimensions, does not closely fit its mating member. Ofttimes dirt and fine chips accumulate in the holes, causing a poor fit. A little attention to these details will save many disagreeable drill troubles. About 90 per cent of drill trouble and breakage is due to loose spindle condition and worn out and dirty taper holes.

Advances in leadership training

A survey which has recently been made by the *Railway Mechanical Engineer* of the developments in foremanship or leadership training in the mechanical department, will be found in another part of this issue and speaks for itself. The progress which has been made in this respect during the past year is little less than marvelous. Two or three outstanding factors are worthy of special notice. It is surprising, for instance, to find that there are so many agencies at work on this problem of training for leadership and that so many of them are available to the railroads if they feel the need of them.

Whether the foremen gather together in a club to listen to addresses and talk them over, whether they meet in staff meetings as many of them always have, or whether they take up the study of leadership in groups or classes, it is advisable that the discussions be conducted in a way which will bring out the very best thought in the group and get all of the members to contribute to it. This is something of an art which has been very little understood until recent years. It is significant that there are now intensive training courses, whose sole object is to train foremen or supervisors to lead such group discussions or conferences. Present indications are that a number of the mechanical department foremen and supervisors will take advantage of such courses during the coming summer.

Another noteworthy development is the increasing number of foremen's clubs. These differ greatly in their types of program and organization, depending upon the local conditions and personalities. Some of them are securing excellent results in developing fellowship and acquaintanceship among foremen and supervisors who have known little of each other in the past except through correspondence, and this has done much to bring about friendly co-operation and to overcome misunderstandings and eliminate needless friction. Then, too, it has been comparatively easy in some cases to trace direct results from the work of these clubs in improved operation or savings of one sort or another. A more or less intangible result which cannot be measured in dollars and cents is the effect upon the morale of the workers due to more intelligent leadership; the possibilities in this direction are claimed by some to be almost limitless.

These are only a few of the important developments that were discovered by the survey, a careful reading and study of which is recommended to all those who are interested in this most vital question of leadership and more efficient management.

A machine tool program

One of the important railroad shops in the south contains an old belt-driven drill press with the date 1869 embossed on the frame. The arrangements for drive and feed are of weird design, as might be expected from the age of the machine, which, however, is in daily use. It is difficult to understand on just what grounds an otherwise progressive road justifies the use of this machine even for the light drilling operations on which it is employed. Lest undue prejudice be charged, it may be stated that a few machine tools, almost if not equally as ancient as the 1869 drill press, are in operation in northern railroad shops. There can be no question, however, that on the whole the general standard of railroad machine equipment has been appreciably raised in the past few years.

This is as it should be, but there is still room for marked improvement in some shops and enginehouses. The best results can never be obtained as long as many of the old machine tools and shop equipment now employed are continued in service. Not all railroad officers, particularly those in higher executive capacity whose duties involve little direct contact with machine equipment, realize the tremendous development, improvement and evolution which have taken place in shop machinery in the past few years. For example, a nationally known manufacturer of machine tools does not build a single machine in 1926 which resembles that type of machine made in 1920 except in a very general way. And the changes are not confined to "body lines" as is sometimes done to stimulate sales with yearly models of automobiles. Increased power, reduction of hand operations and studied layout of the whole design to permit maximum machine output with minimum operator effort are embodied in the new machines.

The modern standard and special machines now available for use in railroad shops and enginehouses are a splendid tribute to the toolmaker's art. At least one railroad has studied its machine tool situation with a view to replacing antiquated types, dividing the new machines needed into three groups: Those which will pay for themselves in six months; those in one year, and those in two years. Is this not a logical basis upon which to approach the problem and will not such a study make a forceful appeal to the executive who must approve of the expenditures?

Apprentice gatherings

Several significant developments have taken place in recent months in the group activities of apprentices on different railroads. An article elsewhere in this issue tells of the third annual apprentice conference on the Santa Fe. During the early part of May all of the apprentices on the Missouri-Kansas-Texas gathered for two days at Parsons, Kan. The visiting apprentices had an opportunity of going through the shops on the first day and a banquet was given in the evening, which was attended by several of the general officers, as well as by the local supervisory officers and foremen. The young men had a rousing time and in addition to several short talks, listened to an address on the economic importance of the railroads, the work of the mechanical department and the part which it plays in railroad operation, suggestions as to the boy studying to fit himself for the future, together with some

words of inspiration and encouragement. On the following day—Saturday—a baseball match was played between two of the apprentice teams which had made the best records up to that time.

A few days later all of the apprentices at Topeka on the Santa Fe had the pleasure directly after the shop closed of a personal message from the assistant to the vice-president who is in charge of the mechanical department, and also of hearing an address much along the lines of the one above mentioned at Parsons. During the latter part of May all of the apprentices at the West Springfield shops of the Boston & Albany held a rally and were addressed during working hours along lines which were helpful and encouraging.

These things, added to the splendid work which is being done among limited groups of apprentices by apprentice clubs, the American Railway Employed Boys Clubs, or similar organization, are doing much to encourage the young men and develop that intelligent booster spirit which is so necessary in building a spirit of teamwork and co-operation among the younger group. Young men who have such opportunities are bound to take their jobs more seriously and to relieve the supervisory staff of a good bit of trouble that may be caused by those who are careless and indifferent about their tasks and do not have a proper appreciation of the dignity and importance of their work.

Does apprentice training pay?

An interesting situation as to apprentice training exists in the mechanical departments of railways in the United States. Slowly but steadily the number of roads that are putting in modern, up-to-date apprentice systems is increasing, being patterned more or less after the methods and practices of the Atchison, Topeka & Santa Fe. As a matter of fact, the apprentice supervisors on several of the railroads are graduate Sante Fe apprentices. At the other extreme are a number of roads which are giving little if any attention to apprenticeship; true, they have apprentices, but no one seems to be paying any great amount of attention to them.

Some mechanical department men are saying frankly that they believe that the time for the all-round mechanic on the railroad is about past, and that hereafter the greater part of the mechanics will be specialists, with little if any training except within a very limited range. They are not particularly interested in recruiting apprentices or, indeed, in having apprentices, but take on helpers or handy men and in some cases designate them as helper apprentices. The advantages of a modern apprenticeship system, which will prepare all-around mechanics, as contrasted to the other type, is clearly developed in the article on "Railway Apprentice Training" by T. C. Gray, supervisor of apprentices, Missouri-Kansas-Texas, in the May number of the *Railway Mechanical Engineer*, page 269.

Those railway mechanical department officers who have given modern apprenticeship methods a thorough trial are enthusiastic over the results. In the first place, it is possible to attract a higher type and better educated boy to the service. In the next place, if schoolroom training is co-ordinated with the work in the shop and his activities in the shop are closely supervised, the boy develops rapidly. Much less work is spoiled, the quality of the work is far higher, and the output is very considerably increased—enough so, indeed, to pay well for the cost of the better type of training and the loss of time from the shop in the schoolroom.

The moral side of apprentice training is ordinarily also stressed, as was recommended and outlined by F. E. Lyford, apprentice supervisor of the Lehigh Valley, in the April number of the *Railway Mechanical Engineer*, page 214. This has a distinct reaction upon the improvement of morale and cannot be lightly regarded for its effect in making better workers in the shop as well as better citizens for the community. The men who now head the most progressive apprenticeship departments on American railroads are very much alive to developing and strengthening the character of the apprentices under their charge.

It is becoming more and more the practice also to see that the apprentices are given information about the economics of railroading and the relationship of the railroads to the community. This is making real boosters of them. It is interesting to note how the community reacts to this intelligent booster spirit on the part of the younger men. It is doubtful if many things could be done by the railroads which would have a more pronounced effect on getting the good will of the public than by having it generally known and recognized that the managements were interested in improving the standards of and helping the younger men.

Another advantage of a thorough apprentice training is its value in attracting and developing boys and young men who have leadership talent and can be promoted to supervisory positions. Too little attention has been given to this question of training men for supervisory positions. Such training should start early and several mechanical superintendents emphasize the importance of good apprentice training as a foundation for future foremen and supervisors.

It is impossible to equate all of these advantages on a monetary basis, but those who have tried out modern apprenticeship methods insist that they pay big returns upon the investment.

Some of the larger roads have developed or are developing excellent courses of training and instruction for the apprentices; some of the smaller ones are having difficulty in this respect. The suggestion was made by C. Y. Thomas, supervisor of apprentices of the Kansas City Southern, in the *Railway Mechanical Engineer* of March, page 155, that sort of clearing house should be established by which the railroads could pool or exchange information as to tests and practices, possibly under the direction of Division V of the American Railway Association. This would ease the burden on the smaller roads of developing suitable tests and the large roads would also profit by the exchange of such information.

Shop schedules and new machine tools

The railroads of this country have been the object of some adverse criticism from time to time because of the manner in which new machine tools are purchased and because of the fact that, as compared with industrial plants, there has apparently been a lack of appreciation of high-grade machine tools. One of the surprising things which develops when an effort is made to look into the exact conditions surrounding machine tool equipment in both railway shops and industrial plants is the fact that the average modern railway shop compares very favorably in its machine tool equipment with the average industrial plant, with the possible exception of recently constructed highly specialized industrial plants, such as modern automobile shops where production machinery is a vital necessity. Production machinery, as known to the automobile plant, is not a necessity nor has it any place in the average railroad shop be-

cause the type of work is entirely different and in the majority of instances it is not necessary to work to anywhere near as close tolerances. Therefore, in the consideration of machine tool equipment for railroad shops it is a fact that, as in all other industries, certain machines are better adapted than others to a particular class of work.

The real imporant questions to be answered are: First, what kind of machine is best adapted to the job at hand; and second, how can a mechanical department officer feel reasonably certain that he is going to get the kind of machine he wants?

Machine tools, while they may be of vital importance to the men at the head of the mechanical department, are of relatively less importance to the executive officer from whom the mechanical department officer must get his appropriation to purchase them. One thing in which the executive officer is always interested, is in knowing whether or not the money which is spent for new equipment will produce savings in operation and if so, how much. It does not seem logical to suppose that it would be a difficult matter to get just the kind of machine that a mechanical department officer might want for a particular job if, in requisitioning that machine, indisputable data were given to show whether or not that machine would save money and if so, how much.

In many instances under the present system of buying machine tools, the purchasing department is allowed a great deal of leeway and naturally price is the dominant factor where, to the purchasing department, quality and productive capacity seem to be nearly equal. One development that has taken place in the railroad shops within the past few years which is of great importance in machine tool selection is the development of shop scheduling systems. Directly, shop schedules exert little influence over machine tool selection but indirectly they lead to the development of information that should give the mechanical department officer an irrefutable argument when he requests the purchase of a machine of some particular make and type. Shop schedules, intelligently developed and applied, will give a picture of the operation of a whole shop. Many schedules embody the use of reports which record the departments or operations which are consistently falling down on the job. To a progressive shop supervisor, such a record should lead to an investigation of the cause for consistent delays in any particular department. Poor shop operation, as a whole or in any unit, can be attributed to some shortcomings either in men, methods or machinery. It may be that the methods involved in any particular case are the best that can be used with the present equipment. It may also be equally true that the present machine tool equipment is producing all that it is capable of producing. It should not be a difficult matter, knowing where the weak spots are, to make time and costs studies which will show how much could be saved by changing methods and machinery, and if the proper kind of study is made on machine tool operations, there should be little difficulty in selecting the kind of machine that would best handle the particular job under consideration.

As a final suggestion, would it not be worth while trying out at the time the next request for a machine tool appropriation is submitted to eliminate entirely a list of individual machines and their estimated cost and substitute instead a statement showing the total appropriation requested together with a general report explaining what improvements are planned, what savings may be expected and what the effect on the maintenance of equipment cost will be. Provided an adequate saving can be shown, it is doubtful whether any progressive executive officer will refuse to listen to a request for appropriations, the expenditure of which can show as great a return or a larger return than the appropriations for equipment requested by other departments.

New Books

Locomotive and boiler inspectors handbook, *by A. J. O'Nail, locomotive inspector, Public Service and Transit Commission for the State of New York. 274 pages, illustrated, 4½ in. by 7½ in. Bound in cloth. Published by the Simmons-Boardman Publishing Co., 30 Church street, New York. Price $2.50.*

Boilermakers, machinists, enginemen and firemen may work on locomotives for years and claim that they know an engine from coupler to coupler and from the rail to the sand dome, but when they are required to take a written or oral examination, many of them fail to make a passing mark. The reason for this is that they have gained their knowledge piecemeal over a period of years and have never given serious thought to the fundamental reasons why locomotives and boilers have to be maintained to meet a certain set of required rules and regulations. Many of these men never have had the opportunity to study these rules and regulations and do not know what to expect in a competitive examination for the position of a federal or state locomotive inspector.

The first six chapters cover the laws, rules and instructions for the inspection and testing of locomotives and tenders and their appurtenances as laid down by the division of locomoitve inspection of the Interstate Commerce Commission. The first chapter contains the original locomotive inspection law passed in 1911, and all subsequent additions made to that law up till the present date. It is imperative that all locomotive inspectors thoroughly understand this law as all of the rules and regulations governing the inspection of locomotives on all the railways in the United States are based on these laws which have been approved by Congress. Rules and regulations for the Inspection of Locomotive Boilers, Rules and Interpretations for the Inspection of Steam Locomotives and Tenders, Locomotive and Safety Appliance Standards, are the headings for the following three chapters. Chapter VI contains the rules and instructions relative to the method of preparing and filing the inspection reports required by the Interstate Commerce Commission. This chapter contains reproductions of these reports which are filled out according to standard practice.

Chapter VII contains a list of questions and answers asked in examinations given to those whose ambition is to become a locomotive inspector. This list indicates the type of questions on both boiler and mechanical work which are apt to be given in an examination. The author offers to amplify, on the request of the reader, any questions which may acquire a further explanation. These questions are grouped according to the subject matter, each group headed with a sub-head such as the construction of the locomotive boiler, joints and strength of boiler, combustion and evaporation, boiler inspection and defects, etc.

Chapter VIII contains 52 pages on the rapidly increasing important subject of welding. Welding is a comparatively new process of making repairs which is used very extensively by the railroads. A competent locomotive inspector should know the fundamental principals governing both gas and electric welding and be able to inspect a welded job in order to determine whether the weld has been properly made and whether it will withstand hard service. The application of electric and gas welding to all locomotive parts now commonly welded is thoroughly discussed in this chapter.

Apprenticeship and the Mechanical Division

WEST SPRINGFIELD, Mass.

TO THE EDITOR:

Your splendid editorial in the March issue together with the article by Mr. Thomas of the Kansas City Southern relative to "Standard Apprentice Training," are two fine contributions on an important subject.

Mr. Thomas clearly states the difficulties in this problem which face every railroad in the country with the possible exception of the New York Central and the Santa Fe. He has suggested the logical solution, that is that the A. R. A. through Division V have a committee on this subject which can work out standards, make revisions, and thus make available to all the very much worth-while benefits of apprenticeship.

The faculties of colleges having railway engineering courses and representatives of the Federal Bureau of Vocational Education would also be of great help, if invited to co-operate in this work.

Railroad apprenticeship is of sufficient importance to justify a national grouping of apprentice instructors to meet one or two days as a sub-division of Division V to discuss their problems.

I trust this matter can be called to the attention of Division V of the A. R. A. and proper action taken at its next meeting.

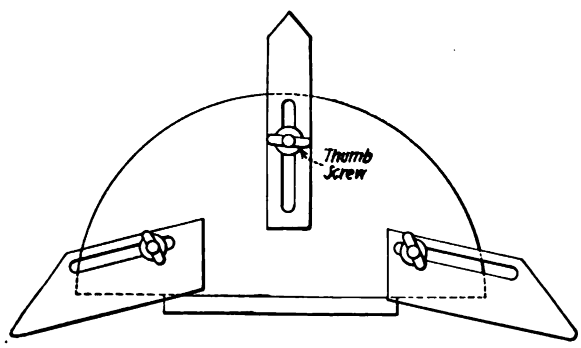
HARRY C. FLETCHER,
Apprentice Instructor, Boston & Albany.

Another gage for laying-off driving box brasses

KANSAS CITY, Mo.

TO THE EDITOR:

The March issue of the *Railway Mechanical Engineer* contained a question from one of your readers who signed



A simple gage for laying of driving box brasses

his name "A Constant Reader" wanting to know a good method of laying off a driving box crown brass for machining to fit in the box after it had been finished on the outside to the diameter of the box.

The gage shown in the illustration has been satisfactorily used in our shop for a number of years. It consists of three adjustable legs mounted on 1/16-in. steel plate. The two lower legs are first set to the contour of the driving box. The top leg is then set to obtain the size of the box.

The brass that is to be laid off is placed up side down on a plane surface after which the set gage is placed with the top leg on the face plate. With the gage in this position, the two edges to be planed are laid off from the two lower legs.

FRANK SOUTHWICK,
Machine shop foreman, Union Pacific, Kansas City, Mo.

Cast iron wheels—A loss or a gain

SAYRE, Pa.

TO THE EDITOR:

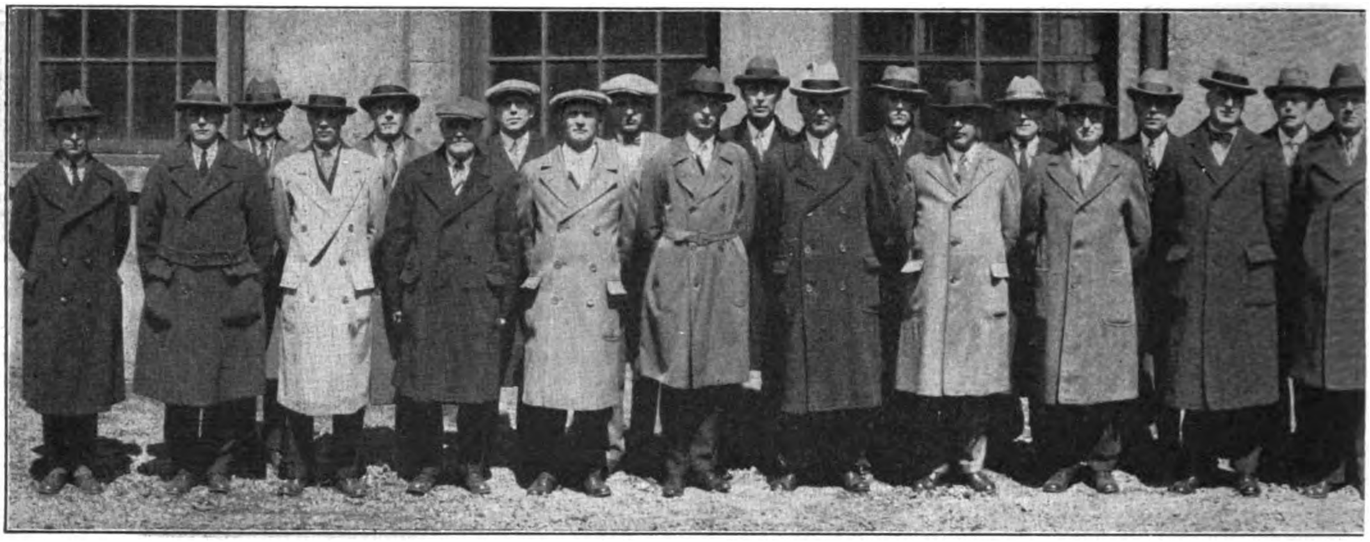
Considerable financial loss can be sustained in a year by negligence on the part of those responsible for the inspection of wheels and axles and the proper billing for them on the billing and repair cards. A good example is found in the case of a pair of 5½-in. by 10-in. cast iron wheels which were removed from a foreign car on a cripple track on account of one of the wheels having a worn flange. The remaining wheel was O.K. according to the standard A. R. A. wheel defect gage and was marked as fit for further service. The removal of the pair of wheels could be classified under the heading of owner's responsibility and credit allowed for two 5½-in. by 10-in. cast iron wheels, one as scrap at $6.30 and the other at $9.55, making a total of $15.85.

This example would apparently tend to show that all parties concerned had received the proper credit allowed in the A. R. A. rules, but after the arrival of this pair of wheels at the wheel and axle shop, which is usually located at some distance from the point of removal, the wheels are inspected by the wheel inspector with the limit gages for the unmounting of cast iron wheels, and it is found that the wheel which has previously been accepted as fit for further service takes the limit gage and is, therefore, condemned as scrap.

A billing and repair card has already been made out covering the removal of this wheel, allowing credit for $9.55, whereas the inspector at the wheel and axle shop has found it to be unfit for further service, and its real value should be $6.30. This difference of $3.25 is a loss to the railroad company whose inspector either did not know of the limit gage used in the remounting of wheels or had failed to make allowance for the difference between the two gages.

This is only one instance of where a railroad can lose money by the neglect of an inspector to carefully inspect wheels and axles.

OLD TIMER.



Nickel Plate foremen's club at Conneaut, Ohio

Training for leadership

Remarkable progress made during the past year in improving standards of supervision

Synopsis

Introduction
Staff meetings
Foremen's clubs
Leadership classes
Leadership for foremanship discussions
Human relations conferences
Co-operative meetings
New Haven educational plan for foremen
Visits to other shops
Apprenticeship as a fundamental basis
Foreman's relation to apprentices
Technical publications and books
Convention attendance
Conclusions

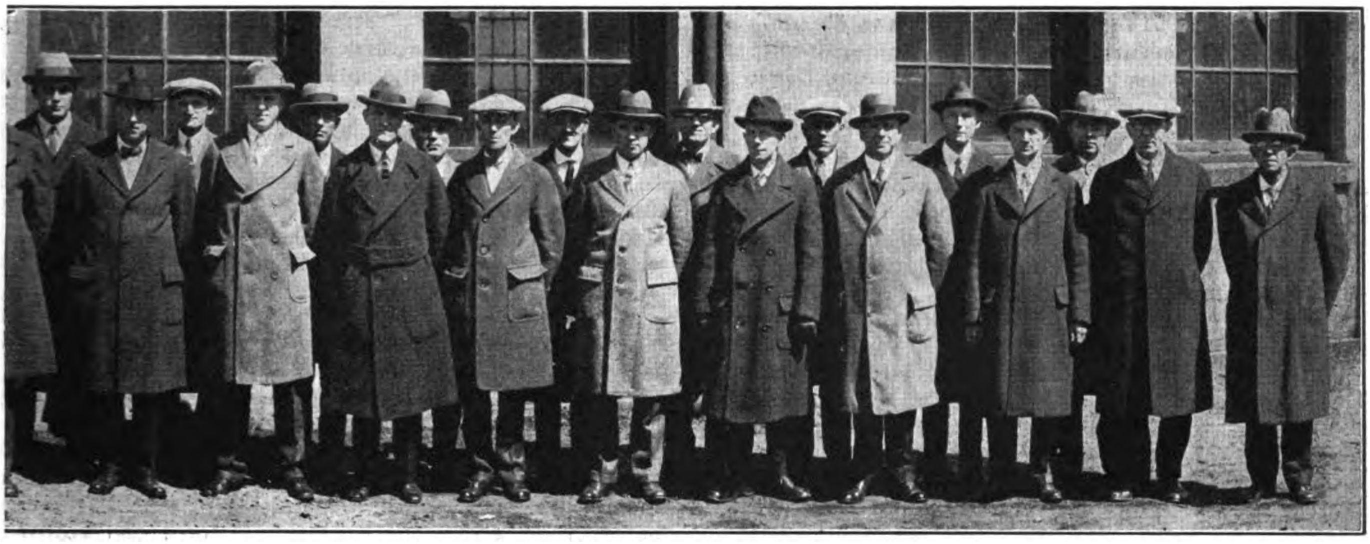
FOR many years the *Railway Mechanical Engineer* has consistently advocated the necessity of encouraging and assisting the foremen and supervisors to study the fundamental principles of foremanship and improve their leadership ability. This publication has insisted that the foremen were really the keystone in the arch of the organization, forming as they do the contact points between the workers and the managements. It is not sufficient that a foreman should be a good craftsman, but far more important is the ability to exercise wise leadership over the men under him. Without such ability friction will surely be engendered with resulting irritation and loss to all concerned. The foreman must be more or less of a diplomat in interpreting the men to the management and the management to the men.

To focus attention upon this vital problem in organization, the *Railway Mechanical Engineer,* in its program last year, attempted to do two things. First, through a prize competition for articles on the opportunities and responsibilities of the foremen, an effort was made to get the best thought from the field and to stimulate discussion of this important question. The results far exceeded our expectations. "Top Sergeant" challenged "Bill Brown" and precipitated a discussion which probably stirred up more interest throughout the mechanical department than any other one question which has ever confronted its foremen and supervisors. Second, a more or less careful survey was prepared for publication in the June, 1925, issue on exactly what was being done to assist the foremen and supervisors in improving their leadership ability. This, too, proved to be stimulating and productive.

Thus far this year the *Railway Mechanical Engineer* has been following up these questions persistently from month to month. The present article is a survey similar to the one made a year ago, but more comprehensive because special steps have been taken to broaden the inquiry and check, to a larger degree than was possible last year, what was being accomplished.

In general, there has been a distinct advance all along the line. The increase in the number of foremen's clubs is particularly noteworthy, while some roads are introducing unusual training measures which promise to give large results. It is significant that both on the railroads and in the industries more attention is being given to the conference method, and a movement which was only started in a small way a year or two ago of intensive preparation of conference leaders, is rapidly gaining strength and popularity.

That industry in general feels the same need for foremanship or leadership training is indicated by the fact that the Department of Manufacture of the Chamber of Commerce of the United States, Washington, D. C., last October issued an excellent report or survey on the "fundamentals in the development of industrial foremen." The Policyholders' Service Bureau of the Metropolitan Life Insurance Company also prepared a similar study, entitled, "Training Key Men in Industry." While neither of these was devised specially for the railway mechanical field, they apply equally as well to it as to other industries, since they are primarily concerned with the principles of



leadership rather than with the methods and practices of the crafts.

So important is this question of foreman training in the eyes of the Chamber of Commerce of the United States that it was one of the major questions discussed at an industrial group meeting, held in connection with the fourteenth annual meeting of the Chamber at Washington in May. The following statement is quoted from the announcement issued by the Chamber of Commerce:

"Restricted immigration, elimination of waste and lost motion, the need for restoring as far as possible the old-time relations between the employer and employee which obtained in the days of the small shop, are some of the reasons why industry is giving special attention to the selection and training of men occupying the important supervisory positions at the lower end of the industrial ladder.

"It has been recognized for some time that the study of human relations is one of the most important factors in successful managing, for notwithstanding the fact that a plant may be equipped to the last word with mechanical contrivances, it is, after all, the attitude of the workman's mind, each day as he enters the plant, toward his employer and his job, which determines whether or not he will get out large or small volume. Moreover, today, because it is an impossibility for the general officers of a concern to come in daily contact with those who are looking after the details of production, some efficient substitute must be supplied; that is, someone who will be able to impart to the workman not only the orders but the vision of management and, on the other hand, transmit to management the feelings and reactions of even the most humble employee, for it takes co-operation clear up and down the line to get results.

"The larger concerns as usual seem to have appreciated first the need for trained foreman, and the training schools and classes existing at present are to a great extent in the larger plants of the country, but not exclusively so, for in many of the smaller places manufacturers have combined or organized and are maintaining and supporting joint classes. The teaching forces are developed in various ways, sometimes in the plant where the training class is maintained; again, by engaging specialists; still again, through the Federal Board of Vocational Training, Young Men's Christian Associations, colleges and universities.

"The Federal government, in co-operation with the states last year, spent $6,198,716.08 on various types of vocational training, a very considerable part of which was devoted to the training of foremen. Recently, the National Association of Foremen was organized at Dayton, Ohio, and several states have state groups of these training classes."

In presenting the following results of our survey, appreciative acknowledgment is made of assistance rendered by mechanical department officers, the extension departments of the state universities, the state departments of education and of vocational training, and Railroad Y. M. C. A. secretaries, as well as representatives of the Industrial Department of the Y. M. C. A.

Staff meetings

It is quite common practice for the supervisors and foremen at the larger shops and engine terminals to hold staff meetings at regular intervals for the discussion of matters of all sorts relating to the shop program or schedule, as well as to organization, facilities and shop practices. This seems to be the most natural way of approaching this entire question of the education and training of the foremen and supervisors. Such staff meetings function as clearing houses and broaden the vision and interests of the department foremen, encourage teamwork and intelligent co-operation and make for closer contacts between the foremen and the officers. In many cases such meetings are on company time and attendance is compulsory.

In some instances the foremen are called together for a few minutes each day to review the situation, check up on any weak spots in the organization or program and plan for the following day's work. Such meetings are usually held on company time or directly after the shop closes. Obviously, there is little if any time for the discussion of the principles of leadership, unless some emergency arises to focus attention upon it. On some roads the daily schedule meetings, as they are sometimes called, are supplemented by regular weekly foremen's meetings, at which time subjects of general interest are discussed and the foremen make recommendations as to methods of performing the work assigned to them. On the Michigan Central, at the St. Thomas shops, for instance, the assistant supervisor of shops attends these weekly meetings in order that there may be an opportunity for comparing the work and practices at St. Thomas with those at other points. The discussion is thus stimulated and a certain amount of friendly rivalry is created, which has an obvious value. Another example is the Missouri Pacific which holds short daily meetings after shop hours; these last from 10 to 30 minutes. It is the practice to discuss briefly the day's operations and outline the program for the following day. Regular weekly meetings are also held at all shops and roundhouse points and in the car department. These are more formal and elaborate.

A goodly number of roads hold similar foremen's or staff meetings at the more important points, either at regular intervals, weekly, semi-monthly or monthly, or as oc-

casion may seem to require. On the Atlanta, Birmingham & Atlantic, for instance, the object of these meetings is "to stimulate interest and educate the foremen better to supervise their forces and handle the work economically and efficiently.

In general, it may be said that while the practice at such meetings is to discuss shop practices and facilities in more or less detail, there seems to be a growing recognition of the importance of exchanging experiences on how best to deal with the human element, although, except in a limited number of cases, it is not evident that special stress is being placed upon this most important question.

On the Chicago, Milwaukee & St. Paul the purpose of such meetings is to discuss "matters pertaining to the local output" and "comparison in output with other points on the system. At these meetings the foremen discuss problems of human relations and methods that will be of mutual advantage to employer and employee."

Weekly Staff Meetings

A large number of the roads hold weekly staff meetings. At some points where such meetings relate mostly to questions concerning the shop schedule, monthly meetings of a more general and extensive nature are also held. This is true of the Union Pacific, the monthly meeting of the latter road being termed a "mechanical efficiency committee meeting."

Semi-monthly Staff Meetings

Semi-monthly meetings are held on the Virginian, at which time shop practices and irregularities are discussed.

The semi-monthly meetings on the Missouri-Kansas-Texas are presided over by the shop superintendent and are held immediately after the shop closes. These are conducted according to parliamentary procedure. Minutes are kept and a regular order of business is closely adhered to. The local storekeeper attends the early part of the meeting, which is devoted entirely to matters pertaining to shop output and material needs. The latter part of the meeting is given over to the reading and discussion of a paper prepared by one of the foremen and dealing with the principles of leadership. The personnel department co-operates by assisting in the development of these papers. While the open discussion is quite generally participated in by those present, the presiding officers do not hesitate to call upon individuals for expressions of opinion—this in order to broaden the discussion and make it as inclusive as possible. The minutes of the various meetings are forwarded to the mechanical superintendent for review.

Monthly Staff Meetings

Monthly staff meetings are held by a number of roads. Attendance at the Minneapolis & St. Louis meetings is compulsory. The monthly staff meetings of the Illinois Traction System discuss car and locomotive failures; safety, reliability, loyalty and co-operation are always stressed at such meetings.

In some cases, as on the Soo Line and the Reading, the mechanical department general staff meetings usually include some of the foremen.

Monthly meetings of the boilermaker foremen are also held on the Reading.

Annual Staff Meetings

Annual staff meetings of a rather unusual type are held by the following groups on the Chicago, Milwaukee & St. Paul: special apprentices; chief clerks; air brake foremen; car department foremen; boiler foremen; traveling engineers; roundhouse, toolroom and general foremen; and master mechanics. The programs for these meetings are planned far in advance of the time of the meeting, much as with any of the national railway associations, and carefully prepared papers and reports are thoroughly discussed. A more or less keen rivalry has grown up between these different groups as to which one can put over the most effective meeting and secure the best discussions. An unusual feature at the annual staff meetings of both the car and locomotive departments is the presentation of prizes for the best operated and maintained local premises.

Foremen's clubs

Much progress has been made during the past year in the formation of foremen's clubs at many points on a number of different railroads, and in the strengthening of the programs of clubs which had already been formed. In general, such clubs are organized on the initiative of the foremen; they meet once a month for seven or more months of the year; the meetings are largely technical, but there is also some opportunity for social features, either at the regular meetings or at the closing session of the season. In some cases, where conditions permit, the meetings are preceded by a supper. The following notes concerning the methods used on some of the railroads may be of interest.

Atchison, Topeka & Santa Fe

The foremen at Argentine, Kans., organized a foremen's club something more than a year ago. It meets on the first Monday of each month at the Railroad Y. M. C. A. building and its object is to create a spirit of co-operation and good fellowship and higher standards of efficiency.

Atlantic Coast Line

Informal meetings of the foremen and supervisors have been held at Florence, S. C., during the past two years. While a club has not been formally organized and the meetings are more or less social in nature, some considerable attention has been given to the discussion of matters relating to co-operation and leadership.

Boston & Albany

A supervisors' club was formed at West Springfield last October, including in its membership officers and foremen. The average attendance for the season has been about 60. The meetings are preceded by a dinner and are held in the Railroad Y. M. C. A. building. Addresses have been made by H. S. Walton, supervisor of air brakes; W. Reichard, consulting engineer of the General Railway Signal Company; F. S. Austin, general storekeeper; J. G. Walber, vice-president in charge of personnel, New York Central Lines; Samuel Bennett, claim agent; and Roy V. Wright, editor, *Railway Mechanical Engineer*. Considerable attention has been given to questions relating to leadership. Of the 61 supervisors eligible for membership, all but three have joined the club.

Boston & Maine

Last year there were eight foremen's educational associations on the Boston & Maine. A new club was recently formed at Worcester as the result of a petition which was signed by every one of the mechanical department supervisors at that place. The various associations or clubs on the Boston & Maine have a system association, which held its second annual banquet and entertainment in Boston on Saturday, May 22. These clubs, or at least those which were first organized, have now been functioning for three years to excellent advantage. They hold, on the average, about seven meetings a year, and while most of the meetings are given over to the consideration

of technical questions, a considerable amount of attention is given to leadership and the relation of the mechanical to other departments in the interests of interdepartmental co-operation. So successful have these educational associations or clubs proved that the stores department at Billerica has recently started a club of its own and it is quite possible that similar associations or clubs will be organized in other departments. The value of such educational associations from the standpoint of a foreman is clearly indicated in the following extract of the remarks made at a recent meeting of the Fitchburg Foremen's Educational Association by the secretary, Philip Cabana:

"Why are we here and why do we hold these meetings? We believe that a better mutual understanding can be attained by bringing men together so that they may compare their experiences. Knowledge is made up not of what one man has found out, but of the accumulated experience of many men.

"Such gatherings as we have this evening are profitable because you and I have a chance to learn what the other fellow thinks. However, to make these meetings worthwhile every man must store something away and apply the knowledge gained to the interest of the Boston & Maine, and at the same time to his own behalf.

"Another purpose of these meetings is to secure a better and smoother organization, happier and more contented employees and officers, the elimination of needless waste, to become more efficient in safety practices and appliances, and to give better service to the public.

"These are the viewpoints which we must carry to our work, so as to be successful. Surely no man is so busy that he cannot afford a little time in learning more about his own work for the benefit of himself and the company he works for. A few minutes in the evenings or a few hours spent, such as we are having the pleasure of spending tonight, will do much for all of us in increasing our knowledge of railroading."

Central Railroad of New Jersey

Foremen's clubs were organized at Elizabethport, N. J., and Ashley, Pa., a little over a year ago and are reported to be in flourishing condition. These meet once a month, except for June, July and August. Papers are read by the members but speakers from the outside are occasionally called in. Entertainment and social features are also included in the programs. The foremen at the Elizabethport shops are also following a university extension course in leadership, as is noted elsewhere in this article.

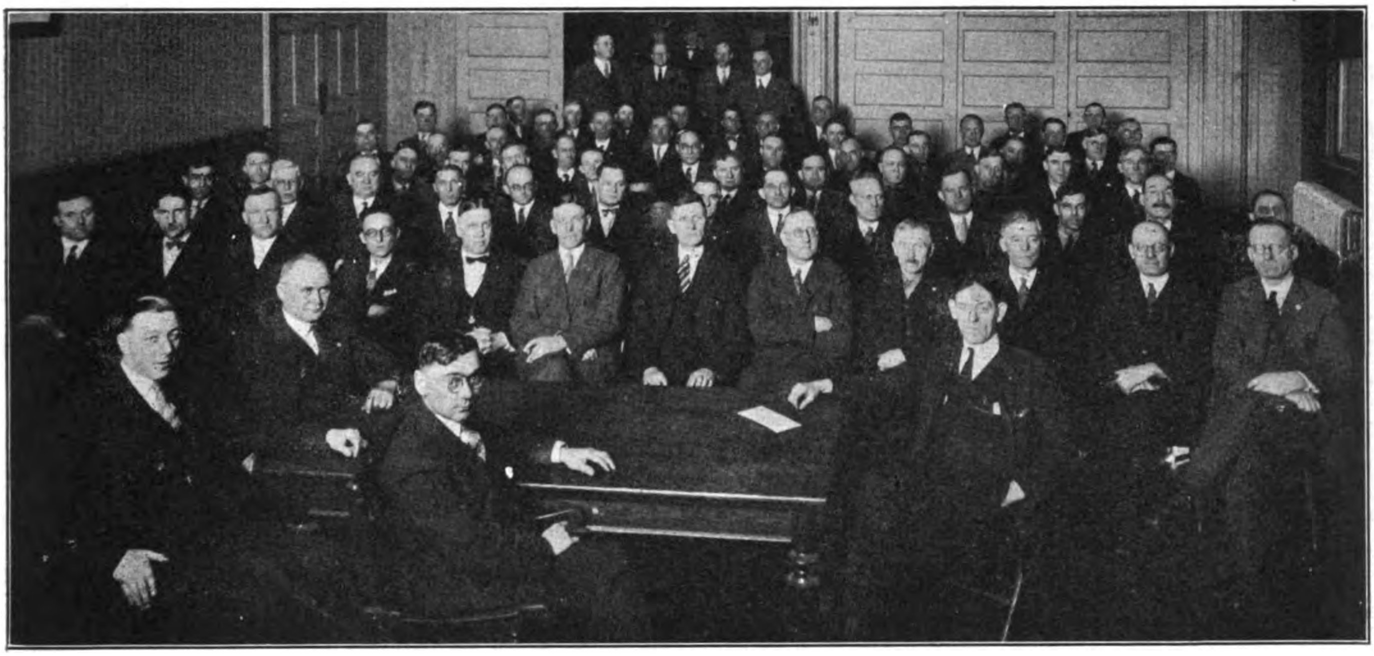
Chicago Great Western

A Foremen's Booster Club meets once a week for a "cost meeting," at which time the various operations are discussed from the cost standpoint. Once a month the club holds a dinner meeting at a hotel. Usually some musical and entertainment features are provided and at least three hours are spent in the discussion of matters affecting shop output and efficiency.

During the year a list of 20 items was prepared, suggesting what the foremen could do to cut down costs, improve quality and maintain production. Each foreman was asked to present in writing his ideas or constructive suggestions concerning these items.

Chicago, Indianapolis & Louisville

A supervisors' organization includes all the men in a supervisory capacity below the rank of master mechanic in both the locomotive and car departments. Ways and means are discussed of increasing production as well as problems relating to employee relations. The program of the regular meetings ordinarily includes certain social features. The foremen hold an annual meeting, which is purely social and to which all of the mechanical department officers are invited.



A monthly meeting of the Scranton Council of the Lackawanna Supervisors, President Hugh Surplus, presiding

Delaware & Hudson

Some of the foremen and supervisors are in a club made up of representatives of the various local industries. Meetings are held in the Y. M. C. A. or at one of the plants. The program ordinarily includes a supper, music, an address, and a well directed discussion.

Delaware, Lackawanna & Western

In addition to the weekly meetings of the department and shop foremen, at which questions relating to production and immediate shop or department problems are discussed, there are three Lackawanna Supervisors' Clubs, known as the Morris & Essex, Scranton and Buffalo Councils. Participation in these clubs is purely voluntary

on the part of the supervisors, and they entirely finance the expenses. The meetings are given over to a consideration of questions relating to the fundamentals of successful foremanship, interdepartmental relationships, and various matters relating to the railroads, economic and otherwise. In addition to these purely Lackawanna clubs, the supervisors and foremen are encouraged to affiliate with city industrial clubs where such have been organized. An example is the Scranton Industrial Club, which meets at the Central Y. M. C. A. for the discussion of leadership problems. There is an obvious advantage in getting an interchange of ideas on the part of representatives of all of the industries as to the best methods of leading the workers and improving relations with the employees. The president of the industrial club at Binghamton, N. Y., which was organized by the Central Y. M. C. A. a year and a half ago, is the master mechanic of the Lackawanna, at that point, M. A. Quinn.

An important factor in the success of the Lackawanna Supervisors' Clubs is a monthly publication known as "The Lackawanna Supervisor," published in the interest of the mechanical department employees. It is 7½ in. by 10½ in. in size and ordinarily contains 24 pages, including an attractive cover.

Duluth & Iron Range

There is a supervisor's club at Two Harbors, Minn. The program ordinarily includes one or two technical papers by members. These are thoroughly discussed and special efforts are made to promote good fellowship.

Minneapolis & St. Louis

The foremen at the principal shops at Marshallton, Iowa, have a club which meets once a month. Papers are prepared and read by the members. The club has been in existence for two years.

Missouri-Kansas-Texas

There are foremen's clubs at the more important points, which meet once a month; during the summer picnics and outings are held. The programs include debates, addresses by representative men and discussions of various sorts. The club at Parsons, Kans., recently held a debate on railway electrification vs. steam operation.

New York, Chicago & St. Louis

Foremen's clubs were organized about a year ago at each of the main shops. A meeting is held each month after working hours and papers are prepared or read by the members. Special attention is given to developing the discussions. Experts from railway supply companies are also invited to address the clubs. The foremen in both locomotive and car shops are required to attend the meetings, the program being in charge of a committee of three, appointed by the shop superintendent. No difficulty is found in getting the foremen to prepare papers, since the author of a paper is given permission to visit the other shops at the next foremen's club meetings. This gives them an opportunity to look into the shop practices at the different points and also to take part in the discussions at the other club meetings. During the past season the following topics have been discussed: Training of foremen; training of apprentices; locomotive forgings; hot boxes; engine bolts, car bolts and staybolts; maintenance of air brakes; systematic method of good housekeeping and surroundings; accounting; locomotive and car inspection; inspection trips to other shops; pipes and pipe fittings for locomotives and cars.

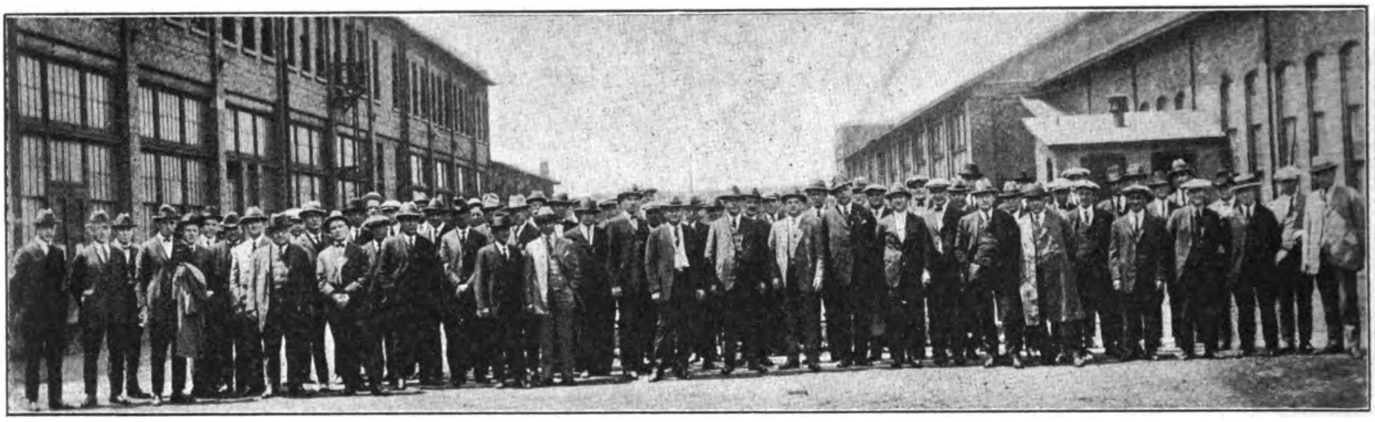
Northern Pacific

The supervisory officers hold periodical social functions in the interests of creating a friendly and co-operative spirit.

Pennsylvania Railroad System

A complete report of the foremen's clubs on this system was given in the *Railway Mechanical Engineer* of June, 1925, page 365. The nine clubs mentioned in that article have just passed through a successful season. Each club has a president, a vice-president, a secretary, a treasurer and an executive committee. The clubs decide jointly upon the general program to be followed and as to a uniform program of subjects and speakers. The local club arranges for the meeting places, entertainment and the fixing and collecting of dues from its members, etc. Only employees occupying supervisory positions are eligible; this includes track foremen, gang foremen in the shops, and chief clerks, as well as the higher officials in all departments. The courses are now limited to eight bi-weekly meetings. Some of these clubs meet in the Railroad Y. M. C. A. buildings, while others meet in the local high schools. At some places, such as Sunbury, Pa., for instance, certain of the meetings are preceded by dinners.

A typical program for the past season is that of the club at Harrisburg. The topics and speakers were as follows: Army discipline, by J. W. Study, chief clerk to general manager, Eastern region; discipline in the abstract, by W. H. Ridgway, president, Craig Ridgway & Son Company, Coatesville, Pa.; railroad discipline, by C. I. Leiper, assistant general manager, Eastern Region; the high cost of poor work, by S. M. Vauclain, president, Baldwin Locomotive Works; highway motor transportation and the railroads, by F. J. Scarr, supervisor motor service; the psychology of handling men, by A. B. Van Ormer, professor, department of philosophy, Juniata Col-



The general foremen on the Chicago, Milwaukee & St. Paul meet together annually

lege, Huntingdon, Pa.; railway fuel, its cost and its use, by William Elmer, special engineer.

Reading Company

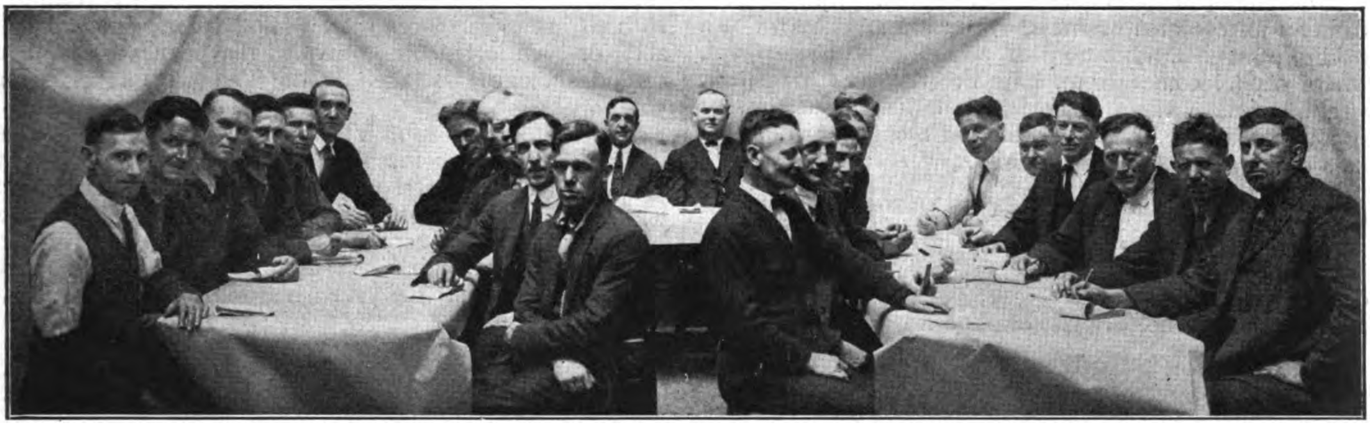
There are three foremen's clubs on this system—at Philadelphia, Pa., Reading, Pa., and Shamokin, Pa. Monthly meetings are held, which combine both educational and social features.

Southern Pacific Lines

A foreman's club was organized at the Houston, Texas, shops about a year ago, the membership including both locomotive and car department foremen and supervisors. Monthly meetings are held, which include short addresses and some form of entertainment. One of the objects of the club is to familiarize its members with railroad subjects so that they can discuss them intelligently in public. Recently the foremen at the Houston shops, with some from San Antonio, attended a course of lectures on human engineering by Dr. A. F. Sheldon. A similar course at New Orleans was also attended by the foremen at the Algiers, La., shops.

Union Pacific

This system has a Mechanical Supervisors' Association, which considers all matters pertaining to the supervisory staff. This is in addition to the staff meetings and to the Council meetings which are held each month and at which the supervisory staff and representatives of the employees discuss matters concerning efficiency and economy.



Meeting of Foremen's Booster Club, Chicago Great Western, Oelwein, Iowa

Wabash

There are two foremen's clubs on this road, one at Decatur, Ill., and the other at Moberly, Mo. These meet monthly and have been in existence about two years. Foremen, gang leaders and lead men in the mechanical department are eligible. Papers are prepared by the members and reports are also made by those who have had opportunity to visit other shop points. Better acquaintanceship is fostered by occasional dances or social features.

Leadership classes

In a number of cases leadership or foremanship classes have been inaugurated at different places on some of the railroads, with the help of the Y. M. C. A., the extension department of a state university, or a state department of education or vocational training. Several things are necessary to make such classes a real success. They must be conducted under strong and efficient local direction and must have properly equipped leaders. A few years ago one railroad arranged with a state department of education to conduct a class for foremen. It started off with considerable enthusiasm, but did not last long. The instructor did not understand practical work, having had no experience in it. For this reason his problems were not at all practical and the classroom atmosphere was entirely too theoretical. Fortunately most of the university extension departments or state education departments have recognized the necessity for putting the right kind of man in charge of such classes, so that the percentage of failures is now comparatively small.

Boston & Maine

In addition to the foremen's educational associations, which are mentioned elsewhere under the heading of "Foremen's Clubs," an experiment has been tried out this year among the foremen at Concord, N. H. The University of New Hampshire, co-operating with the Railroad Young Men's Christian Association, has conducted a class which thus far has given its attention largely to technical subjects, starting with mathematics, and including elementary physics, mechanics of materials, mechanics of elementary machines and blue print reading.

Central Railroad of New Jersey

Rutgers University, New Brunswick, N. J., has recently established an Industrial Extension Department under the direction of Prof. N. C. Miller, who was formerly associated in a similar capacity with State College, of Pennsylvania. Professor Miller recently started a course on foremanship at the Elizabethport shops. The class meets once a week.

Grand Trunk Railway

The supervisors at the Battle Creek, Mich., shops of this railway a year ago joined with representatives of industry in that locality in a foreman training class under the direction of the Vocational Education Department of the University of Michigan. Excellent results were obtained.

Railroads in Iowa

The Engineering Extension Department of Iowa State College at Ames, Iowa, has been quite successful in fostering a number of classes in foremanship at various points on some of the railroads which operate in the state of Iowa. In general this course includes 15 meetings a year, the complete course being covered in a period of about three years. Such classes were conducted on the Chicago, Burlington & Quincy at Burlington during the past two years; on the Chicago, Rock Island & Pacific at Cedar Rapids during the past three years, and at Valley Junction in 1924 and 1925; on the Chicago & North

Western at Clinton during the past three years; at Boone in 1922, 1923, 1924 and 1925, and at Missouri Valley in 1922; on the Minneapolis & St. Louis at Marshalltown in 1921, 1922, 1924 and 1926; on the Chicago Great Western at Oelwein in 1924; and on the Chicago, Milwaukee & St. Paul at Dubuque, in 1926.

Lehigh Valley

Mention was made in our survey a year ago of the two foremen's classes at Sayre, Pa.; one in the Sayre system shops and the other under the direction of the master mechanic of the Seneca division shops and enginehouse. Both of these classes were following the foremanship training course prepared by State College of Pennsylvania. This course was carefully drawn up on the basis of numerous conferences with industries throughout the state of Pennsylvania and has been thoroughly tried out. A representative of the university ordinarily assists in getting such a course started and may occasionally come to and address the class after it is organized. On the Lehigh Valley the supervisor of apprentices has charge of the class in the system shops and the master mechanic directs the work among the division foremen and supervisors. One of the local officers or a member of the class ordinarily opens the discussion.

An advanced course is also being given this year at Sayre on economics for public utility workers. This is a new course and covers in general the following topics: The development of industry, how a public utility differs from an unregulated business, ownership and control of a public utility, organization of a public utility, capital, where capital comes from, how the revenues are spent, wealth, money, wages, materials and their value, law of supply and demand, competition and monopoly, the business cycle, summary and conclusions.

Michigan Central Railroad

Many of the supervisors at the Jackson, Mich., shops are members of a foremen's class which is conducted under the direction of the Y. M. C. A., and includes representatives from the various industries.

Southern Pacific

The State Supervisor of Trade and Industrial Instruction of California, in co-operation with the officers of the Southern Pacific, conducted a foreman training conference at the Sacramento shops, beginning April 6.

State educational department facilities

A number of states, through their departments of vocational education, have rendered service along the line of foreman training, the Federal Board for Vocational Education, under the direction of Frank Cushman, chief of the Industrial Educational Service, co-operating in many instances. The following states, in addition to those mentioned elsewhere in this survey, are interested in this development and are prepared to assist the railways.

The state supervisor of trade and industrial education of the Department of Education of Arkansas, is prepared to assist roads in foremanship training.

The state director of vocational education of Connecticut is prepared to co-operate with the railroads in foremanship training.

The state supervisor of industrial education of Maryland, who is also professor of industrial education at the University of Maryland, has conducted foremanship training classes for the industries and stands ready to help the railroads.

The Department of Education of Massachusetts is prepared to conduct foreman training classes covering eight periods or lessons, preferably given one a week and each lasting one and a half hours. This service has been available since January 1, 1926.

The Department of Education of Mississippi, under the direction of the supervisor of trade and industrial education, is prepared to co-operate with the railways in foremanship training.

The Department of Vocational Education of the State of Montana in 1925 conducted a foremanship conference with foremen from the Chicago, Milwaukee & St. Paul shops at Deer Lodge, and more recently has held a similar conference with foremen of the Northern Pacific shops at Livingston.

The Ohio Trade and Industrial Education Service, under the Division State Board for Vocational Education, has conducted foreman training work in the industries and is prepared to co-operate with the railroads.

The Department of Vocational Education of the State of Oklahoma in 1925 conducted conferences for the railroad foremen on the St. Louis-San Francisco. The plan was to meet with the foremen on company time, usually from 10 to 12 in the morning, or from 1 to 3 in the afternoon. The conferences covered a period of three weeks and followed the discussion method. This year similar conferences were conducted with the foremen of the Chicago, Rock Island & Pacific at Chickasha and Shawnee.

The Bureau of Vocational Education of the Department of Public Instruction of Pennsylvania will be glad to cooperate with railroad companies in that state in the development of foreman training and apprentice training. In both instances there are state and federal funds available for such instruction, provided that it measures up to certain standards included in the Pennsylvania plan for vocational education.

The State Board for Vocational Education of Texas has held classes for foremen in street railway service at Fort Worth for several years. Similar classes have been held under the leadership of the foremen of the El Paso Street Railway Company and in Houston and Galveston. The requirements of the steam railroads are so similar that it would seem that such help could readily be extended to them.

The State Board of Education of Virginia has been giving courses on foreman training in industrial sections in that state and is prepared to serve the railroads in a similar manner, if the schedule and its facilities will permit.

The State Board of Vocational Education of Wisconsin stands ready to assist the mechanical departments of railroads in promoting foremanship training. The Extension Department of the University of Wisconsin has co-operated with the industries in a correspondence study department and is prepared to render similar service to the railroads of that state.

The Division of Vocational Education of the Department of Education of Wyoming is planning on organizing a foremanship training class at the railroad shops at Cheyenne next fall.

Leadership for foremanship discussions

Two difficulties present thmselves in starting and conducting foremanship clubs or leadership classes. One is to obtain a leader and the other, inter-related with it, is to build a satisfactory program or select the right kind of a course. The *Railway Mechanical Engineer* has been asked asked these questions many, many times during the past year.

To meet this need certain more or less experimental intensive courses were put on last summer, the object of which was to train men to lead such groups. One such course, for instance, which extended over seven days, was given under the direction of the Industrial Department of the Y. M. C. A. at Silver Bay, N. Y. Another one was

given at the State Normal School at Oswego, N. Y., by the New York State Department of Education, Division of Vocational Extension Education. Both of these intensive efforts to train conference leaders met with considerable success.

The Industrial Department of the Y. M. C. A. has announced plans for a similar conference, to be held at Silver Bay on Lake George, N. Y., August 20-26, under the leadership of Prof. N. C. Miller, now director of the Industrial Extension Division of Rutgers University. Professor Miller built up the Industrial Extension Department of State College, Pa., and has personally organized and taught over 80 different foremen's groups. Some of the men who took the course last year are giving excellent accounts of themselves in conducting discussions at foremen's clubs, or heading up classes in foremanship conducted on the conference plan.

The Division of Vocational Extension Education of the New York State Department of Education has followed the course to prepare conference leaders, which was given last year, by several other intensive courses. One of these at Troy, N. Y., covered nine days and is being followed up by further assistance to those who participated in it. Another course at Utica, N. Y., includes five-hour periods one evening of each month, after which the group will meet daily for one week, in order to complete the course. It is believed that the intensive courses, such as the one given at Troy, are more productive, and the expectation is that such courses will eventually be lengthened to cover a period of as much as three weeks. A three weeks' course will be given at Oswego, N. Y., this summer, covering five hours of conference work each day and requiring about two hours of outside preparation. This work is under Arthur L. Mann, supervisor of industrial education, Albany, N. Y.

An intensive school for training conference leaders is now in session in Omaha, Nebr., under the direction of the Department of Vocational Education of the State of Nebraska. The mechanical department of the Union Pacific has entered a number of its foremen in this course, with the expectation that several foremen's classes will be formed to function under their direction, or at least with their co-operation. The conference is being conducted by Frank Cushing, chief of the Industrial Education Service of the Federal Board for Vocational Education. The purpose of the course, extending about a week, is (1) to make available to those who may attend the special knowledge that has been secured concerning successful methods of carrying on foremanship courses, and (2) to develop ability on the part of those who attend successfully to plan and conduct foreman conferences. A general outline of the course follows:

General Outline of Course

The following is a general outline of the course:

1. An analysis of a foreman's job in terms of responsibilities.
2. Classification of responsibilities with respect to—
   a. Stock.
   b. Operations and processes.
   c. Tools and equipment.
   d. Men.
3. Classification of foremen's responsibilities under the three major headings:
   a. Supervision.
   b. Management.
   c. Instruction.
4. Methods of conducting conferences—How to promote, direct and control discussion.
5. The determination of objectives.
6. Different methods of job analysis and the use of job analysis in connection with foreman training.
7. The use of analytical methods in connection with conference work.
8. The case method.
9. The development and use of auxiliary instructional material.
10. Planning—
    a. A series of conferences.
    b. A single conference.
    c. Planning on the job with respect to unexpected developments.
11. Plant organization and the foreman's relationships in the plant.
12. The foreman as an instructor.

The Estes Park (Colorado) Y. M. C. A. Industrial School has held an annual school for industrial, railroad and business executives during the past four years. The State Board for Vocational Education of Colorado has assisted in putting on a series of demonstration conferences at this school.

The fifth annual school for industrial, railroad and business executives will be held at the Y. M. C. A. conference grounds at Estes Park, Colo., July 18-24. It will be interrelated with the sixth annual Conference on Human Relations in Industry, which will be held July 23-25.

This year the Division of Industrial Education of the Colorado Agricultural College is planning several foremanship conferences; a special effort is being made to interest the railways in this development.

The state supervisor of industrial education under the Colorado State Board for Vocational Education, will conduct an intensive course on leading foremanship conferences or discussions July 9-17, this year.

King, Robinson Company, Buffalo

The Buffalo Council of the Lackawanna Supervisors held its annual banquet on April 10, 1926

Human relations conferences

For a number of years the industries in general have profited greatly from annual conferences on human relations in industry, held under the auspices of the Industrial

Department of the Young Men's Christian Associations. Such conferences, extending over a week-end period of three or four days, include representation from all of the various elements which go to make up an industry, from the financier and executives to the workers. The speakers and conference leaders include representatives of all of the various factors involved in industry, as well as experts on economics and other related subjects. Great care is taken to keep the discussions on a constructive basis and in line with Christian principles. While the discussions frequently are lively and spirited, the net result has been to get the so-called conflicting interests closer together. Such conferences have been warmly commended by all those who have had an opportunity of attending and taking part in them, regardless of their affiliations.

While railroad representatives have frequently been included among the speakers, the railroads in general have not awakened to the value of these conferences. It is significant, however, that for two years delegations from the Union Pacific attended the conference at Estes Park, Colo., and last year delegations made up of representatives of both the managements and the workers from the Chesapeake & Ohio attended the conferences at Blue Ridge, N. C., and Silver Bay, N. Y. Those who were fortunate enough to be included in such groups have expressed themselves enthusiastically over the benefits which they have derived in getting a better conception of the fundamentals involved in relationships between the employees and the managements, and the inspiration which they have received, looking toward constructive measures for improving such relationships.

The seventh annual Southern Industrial Conference on Human Relations in Industry will be held at Blue Ridge, N. C., this year, July 16 to 18. (E. G. Wilson, 412 Palmer Bldg., Atlanta, Ga.). The sixth annual conference at Estes Park, Colo., will be held July 23 to 25. (Chairman, N. R. McCreery, manager, Colorado District, Great Western Sugar Company, Denver, Colo.). The ninth annual conference at Silver Bay on Lake George, N. Y., will be held August 26 to 29. (Chairman, Arthur H. Young, Industrial Relations Counselors, Inc., 165 Broadway, New York.) The conference at Estes Park last year was attended by more than 400 people, the one at Blue Ridge, N. C., by nearly 400, and the one at Silver Bay, N. Y., by 600.

Co-operative meetings

Some of the mechanical superintendents draw attention to the pronounced effect of so-called co-operative meetings between representatives of the workers and representatives of management in ironing out difficulties which have confronted the supervision. The suggestion is also made that such meetings have done much to stimulate the foremen and supervisors to improve their leadership ability. This is said to be true with the various examples of employee representation, as well as with the labor union form of co-operation.

New Haven educational plan for foremen

The mechanical department of the New York, New Haven & Hartford, feeling the responsibility of more definite instructions and better training methods for the foremen, has had in effect for the past 18 months a unique plan quite different from that now followed by any other railroad. The greater number of the foremen are, of course, located in fairly large groups at central points, but many of those in enginehouses, repair yards and smaller terminals are widely scattered in small groups. It was therefore felt that the educational plan should be sufficiently flexible to include all of the foremen and supervisors, even at the most remote points. Indeed, it was thought that the latter were in even greater need of assistance and encouragement than those at the larger points.

It was recognized that any plan of instruction, to be effective, must be intimately related to the man's work; it must be interesting and should stimulate him to think and study. It is one thing to ask or order a body of men to study, but quite another thing carefully to work out a plan which will catch the interest and inspire the men to study—in other words, the plan must be such as to get the hearty co-operation of the foremen. Men working by themselves get into ruts and become narrow-minded. It was thought, therefore, that an endeavor should be made to give each foreman the opportunity of observing and talking over with other foremen the methods and practices at other points. An effort was also made to develop a plan which would insure as permanent results as possible.

The plan as now in effect is three-fold, including (1) monthly examinations, (2) monthly talks on foremanship and leadership, and (3) periodic visits of foremen to other terminals on the railroad.

(1) Monthly examinations. Each month ten questions each are prepared for a dozen different crafts, such as machinist, boilermaker, blacksmith, air brake, car, etc. These questions are based on the particular craft to which they apply, but also include more general matters pertaining to mechanical department accounting, the stores department, the bonus system, Mechanical Department Association rules, etc. Some of the questions are also based on the Interstate Commerce Commission rules and instructions for the inspection and testing of locomotives and tenders and their appurtenances, the American Railway Association rules, and the New Haven permanent instructions and folio sheets.

The question papers are sent to the foremen about the first of each month and the answers must be returned not later than the 25th, all answers being in the men's own handwriting. A series of examining boards has been set up, the chairman of these boards being the chief mechanical inspectors or staff officers in charge of special classes of work. For instance, the chief mechanical and electrical inspectors are chairmen of committees which have to do with papers on steam or electric locomotive machinery. The supervisor of boiler inspection and maintenance is chairman of the board which examines the papers on boilers, the supervisor of auxiliary equipment on those which relate to air brakes, the supervisor of equipment lighting on questions pertaining to locomotive and car lighting, and the general Oxweld inspector on questions relating to welding.

After the papers have been examined and marked they are returned to the foremen, together with a printed copy of the correct answers. They can thus check their papers with the correct answers. A record card is kept for each foreman, showing his marks and the numbers of questions which were incorrectly answered. If a foreman falls below a certain mark, steps are taken to determine just where he is weak and to assist him to overcome the weakness. One result of these examination papers has been the stimulation of much interest and discussion among the foremen; this interest is reflected also in the increased number of questions which are asked of the staff officers as they come in contact with the foremen. Since the questions concern largely rules, practices, etc., relating to the specific work of the particular foreman, the correct answers are valuable for reference purposes.

(2) Monthly talks. Each month a talk is given at the larger and more important shops and terminals on foremanship and leadership. A printed copy of the address is afterwards distributed to each foreman so that he may give it further study. Opportunity is also given for a discussion after each address. Incidentally, after a rea-

sonable time has elapsed, questions based upon information in these addresses is included in the monthly examination papers. The result has been a better understanding on the part of the foremen of the fundamental principles of foremanship and leadership.

(3) Periodic shop visits. The New Haven practice in this respect is fully outlined in the following section entitled "Visits to Other Shops."

Visits to other shops

Several of the railroads are now making it a more or less regular practice to have shop supervisors and foremen visit other shops at such times as may be most convenient. The advantages of such visits, whether they are to shops or repair plants on other roads or different terminals on the same road, are obvious.

The New York, New Haven & Hartford, for about a year and a half, has established a program of periodic visits, the shop foremen being sent to various enginehouses, and the enginehouse foremen to repair shops. Primarily, the purpose is to get the foreman away from his particular shop or terminal for the purpose of observing conditions and methods of doing work, and discussing with other foremen the various problems encountered. The conditions in the repair shop and the enginehouse vary to so great an extent that it is believed that the foremen get more from their visits by studying the different type of work. The foremen are required to submit written reports, giving their observations and making suggestions for changes or improvements. These reports are sent to headquarters and carefully studied.

Such visits have brought about better understandings between the different parts of the organization and have been found to be far more effective in correcting improper conditions and misunderstandings than correspondence; in addition, they have done much to stimulate thinking along constructive lines.

Apprenticeship as a fundamental basis

More and more mechanical department officers are coming to emphasize the value of a thorough apprentice training as a sound basis upon which to develop a successful foreman. A modern system of apprentice training not only makes a good craftsman, but it should give the young man a broad understanding of the importance of the railways and not only of his relationship to his department as a whole, but the part which his department plays in the operation of the railroad. He should also gain some conception of his relations to his fellows and to the community. This is a splendid foundation for a foreman or supervisor, if he has the right sort of a personality and will study to develop leadership ability. It is not to be wondered at, therefore, that several mechanical superintendents emphasize the necessity of a thorough apprentice training as a prime requisite for a successful foreman.

Foremen's relation to apprentices

The foremen are naturally intimately related to the apprentices. On some roads they are frequently called upon to meet with the apprentice and A. R. E. B. clubs to talk to and counsel with the members.

On the Missouri-Kansas-Texas the foremen are honorary members of the apprentice clubs. The practice on the Chicago Great Western is to assign the foreman to prepare papers to be read before the apprentices. These assignments are made by the shop superintendent or general foreman and papers are presented at least twice a month, sometimes more frequently. The apprentices are invited to ask questions after the foreman has given his talk. This is not only very helpful for the apprentices, but is splendid training for the foreman. In preparing his paper he must go into his topic thoroughly and think it through, and must study to express himself in such a way as to be clearly understood. This is excellent practice, particularly since the boys are pretty keen in asking questions and the foreman must be fully prepared when he appears before them.

Technical publications and books

On a number of roads the foremen are either encouraged to subscribe to a technical publication in their field, such as the *Railway Mechanical Engineer,* or are required to report upon articles in such publications to which their attention has been specifically directed.

On the Delaware & Hudson the mechanical superintendent requested each supervisor and foreman to prepare a written comment on the articles by "Bill Brown" and "Top Sergeant," which were published in the *Railway Mechanical Engineer* some months ago in connection with the competition for the best articles on the responsibilities and opportunities of the foremen. These papers—nearly 200—when copied and bound, formed several imposing volumes and have been the basis of a series of talks by the mechanical superintendent to the superiors and foremen.

The number of good books relating directly to railway mechanical department practices and to questions of management are rapidly increasing. The foremen should be encouraged to read and study these books and more attention should be given to building up libraries of such books at the various points.

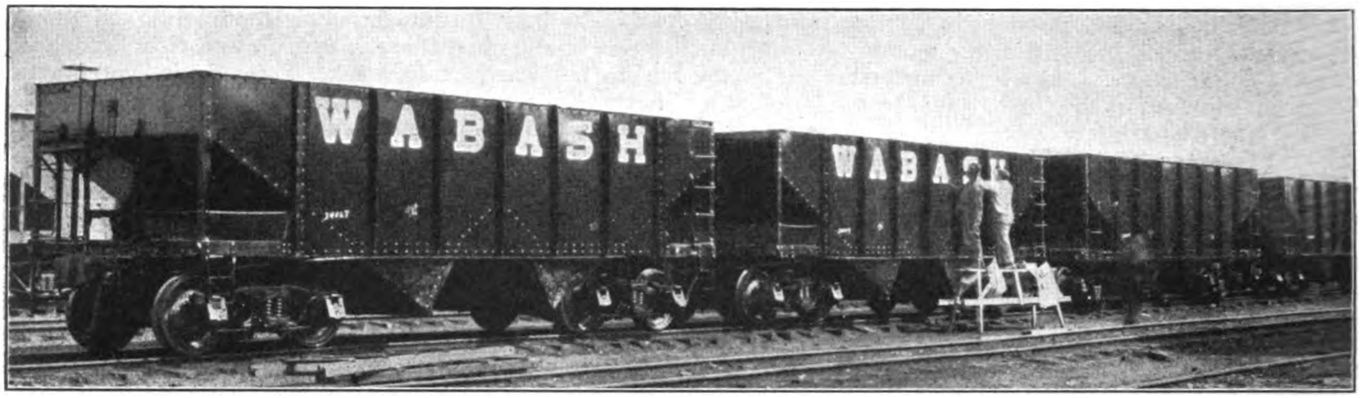
Convention attendance

More and more foremen are being encouraged to attend conventions and to participate in the preparation of the committee reports and in the discussions. Contact with men of their own crafts from other roads has worked wonders in developing some of them. These conventions should not be regarded as vacation trips. Many managements feel that it is an excellent investment to send foremen to such meetings at company expense. In such cases the men are frequently requested to report on those things which made a special appeal to them as being best suited to the solution of their own problems. In asking for such reports it is just as well to specify that a complete detailed report of the meeting is not required, but rather a clear-cut statement of those things which appealed to the foremen as having a real value as applied on his own road.

Conclusions

This study covers in general what we believe to be the more important factors which are involved in assisting the foreman and supervisors to develop that standard of leadership ability which is so necessary in these days if we are to operate most efficiently and with the greatest economy. Obviously the nearness of attainment to this objective will depend upon the extent to which cordial co-operation can be induced between the workers and the managements and friction removed. Leadership ability on the part of the foremen is thus just as important as lubrication to a machine.

Doubtless some things may have been overlooked in this survey. There may be in process in the mechanical departments of the railroad's important developments in foremanship training which have escaped our notice. It is our purpose to publish a further article on this subject in the September number of the *Railway Mechanical Engineer,* which will gather together such things as our readers may find that we have overlooked in this study or developments which may take place after this material was compiled. The co-operation of our friends and readers in thus rounding out and completing this survey will be greatly appreciated.



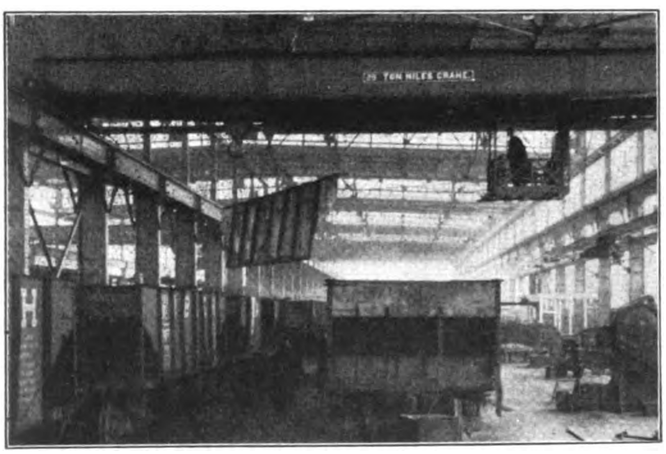
Final painting and stenciling operations are done outside the shop

Wabash builds steel car shop at Decatur

Modern plant with track space for 66 cars and potential output of 15 cars a day

ON February 15, repair operations were started in the new steel car shop of the Wabash, recently constructed for that road at Decatur, Ill., by Dwight P. Robinson & Co., Inc., New York. With modern crane and machine equipment and track space for 66 cars, the shop is capable of organization for an output of 15 rebuilt cars a day. While production to date has not nearly reached this figure, owing to the employment of a relatively small force of men on steel car work, commendable results have been secured, with all indications pointing to steady improvement as the new facilities are more fully utilized.

For purposes of comparison, the following figures are



One of the 25-ton cranes which save time and labor in handling heavy steel car parts

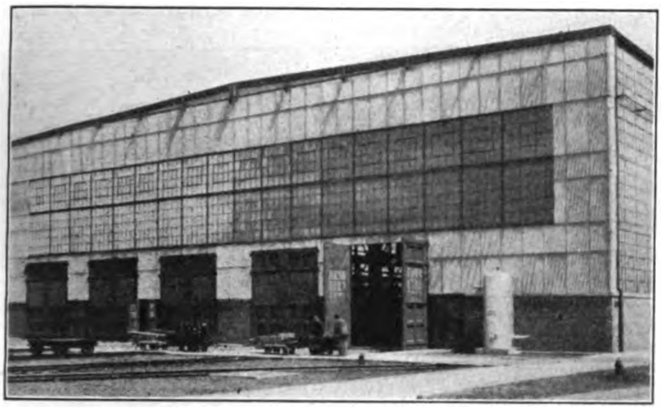
of interest. In January, 1926, 38 steel hopper cars were repaired in the shop yard at Decatur without any shelter. Twenty-seven cars of the same series were repaired in the new shop during the last half of February with reductions of 16.5 per cent in labor and 18.2 per cent in material costs per car from the figures in January when the work was done in the shop yard. In March, 76 of these cars were turned out of the new shop with reductions of 21 per cent and 32.9 per cent respectively, from the January figures for labor and material costs. The reason for the considerably improved labor showing in March over February is explained by increased familiarity of the men with the power riveting machinery, and a general checking and tightening up of operations on each car. The reduction in material costs was due to the large amount of straightening work made possible by the oil furnace, face plate and pneumatic clamp installed in the steel shop. Heretofore a considerable amount of angle iron was scrapped on account of the great cost of straightening which exceeded the cost of new material. Modern facilities for straightening angle irons and other structural shapes have made possible a material reduction in the amount of new steel required.

Decatur center of coal and grain districts

Decatur was selected as the site of the new steel car shop because, being in the center of the coal district and also the grain district, coal cars and box cars of steel design can be repaired at this point with a minimum of empty road haul. The shop was designed to meet every modern condition encountered in rebuilding steel freight equipment on a production basis at low unit cost. The shop building, of brick and steel construction with a large proportion of window area to assure adequate light, is 594 ft. long by 126 ft. wide, having a total floor area of 74,824 sq. ft. It is heated in winter, being kept as nearly as possible at a temperature of 50 deg. F. The building is 41 ft. 11 in. high, with a height from the floor level to the bottom of the roof truss of 33 ft. 4 in. and 25 ft. from the floor level to the bottom of the traveling cranes. This distance of 25 ft. under the traveling cranes permits car trucks, steel sides and other parts to be handled safely over the tops of cars.

The shop is divided into two longitudinal bays, each having a Niles 25-ton crane traveling east and west the entire length of the shop. Three tracks in the north bay are equipped with permanent scaffolds for the repairing of steel coal cars and steel underframe box cars. The

scaffolds are of unusual width to facilitate easy work and handling of material, this width being made possible by spacing the tracks 20 ft. on centers with 12 ft. between each outside track and the outside wall. The south bay,



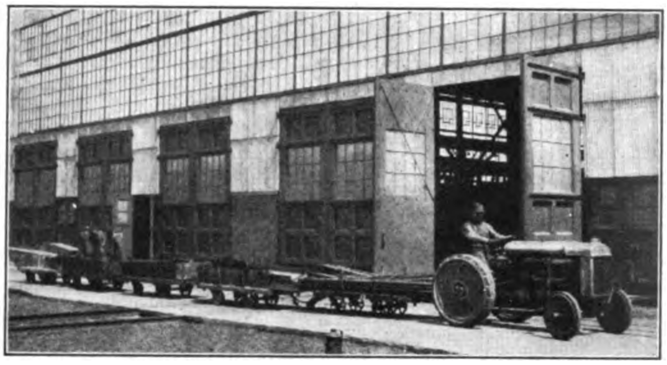
West end of Decatur car shop—A structure built of brick and steel with large proportions of window area

where steel coal cars are repaired, has two tracks running the full length of the shop and one 300-ft. track extending only to the center of the shop.

The shop machinery, located for the most part along the south wall of the building, as shown in the drawing, was not intended for fabricating all the steel parts used in the cars. It was, however, carefully chosen with a view to the expeditious handling of heavy steel car repair work and the fabrication of such parts as it was felt could be economically made in a shop of this size. The machine equipment, location and type, is shown in the drawing.

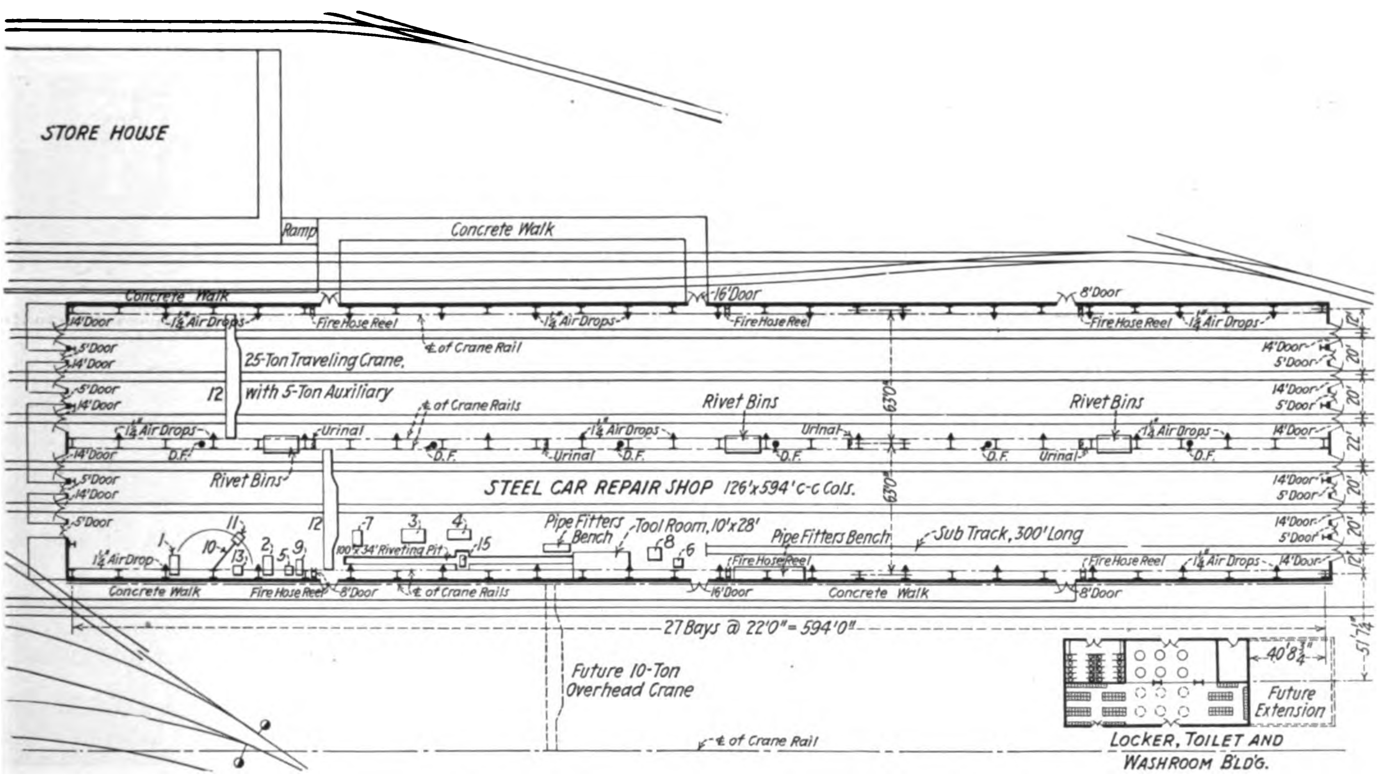
A post crane with 18-ft. boom and a portable Hanna pneumatic riveter is used in assembling and riveting the steel car sides and channels. A certain proportion of the riveting work on these parts is best performed in the 110-ft. riveting pit used in conjunction with a Hanna gap riveter with 75-in. reach and 18-in. gap, which develops pressures up to 70 tons. The Johnston oil furnace and face plate, in conjunction with a car wheel boring machine converted into a pneumatic clamp by the addition of an air clyinder, are used in the straightening and forming of car parts.

The toolroom, located in the center of the shop on the south wall, occupies a central position and performs the



An important factor in the shop output is the tractor and trailer system of handling material

important function of supplying the men with the right kind of tools, when needed. Another feature of the shop is the location of a small cut-off saw and a rip saw near



Layout of the steel car repair shop of the Wabash at Decatur, Ill.

Mach. No.	Description	Motor hp.
1	Pels single and vertical punch	5
2	Pels combined shear, bar, angle and tee cutter	15
3	DeRemer-Blatchford Economy type oil-burning furnace	5
4	Wabash cast iron face plate	..
5	Niles-Bement-Pond double grinder	3
6	Fay & Egan inverted swing cut-off saw	7½
7	Pels triple gag punching machine	5
8	Fay & Egan iron frame ball bearing rip saw	7½
9	Niles-Bement-Pond sliding head drill	5
10	Wabash post crane with 18-ft. boom	..
11	Hanna gap riveter, 12⅞-in. cyl., 18-in. reach, 15-in. gap	..
12	2—25-ton Niles cranes with 5-ton auxiliaries	117 each
13	Johnson oil rivet heating forge	..
15	Hanna riveter, 75-in. reach, 18-in. gap, 70-ton pressure	..

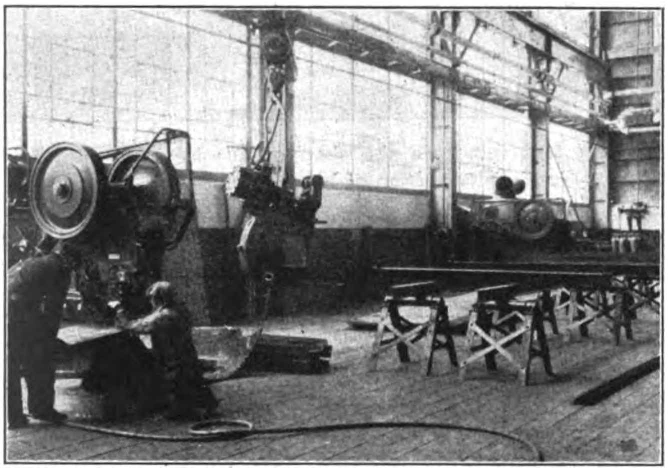
the toolroom to save time going to the mill room to rip or cut off the limited amount of lumber used in this shop.

Three rivet bins located at intervals along the center of the shop save time and labor in keeping an adequate supply of rivets always available when needed. The shop is provided with numerous $1\frac{1}{4}$-in. air drops at convenient locations and also a number of drinking fountains and urinals.

Material handled by tractor and trailer system

The expense of handling other material has also been reduced to a minimum by delivering it to the shops in large quantities, by means of two Rex Ford tractors and six trailers, avoiding as much as possible unloading on stores department platforms and re-loading for shop delivery. Concrete walks and platforms 10 ft. and 12 ft. wide are provided and enable tractors and material cars to pass each other without getting off the walks.

Another feature is the unusually well-arranged and clean locker, toilet and wash room located as shown in the drawing. This building is provided with steel lockers for the men's clothing, six Bradley wash fountains in which ample warm water is available for washing purposes, and a series



Close-up view of combined splitting shear, bar, angle and tee cutter; Also Hanna portable riveter suspended by Ingersoll-Rand pneumatic hoist from post crane and used in conjunction with assembly jig mounted on rollers

of plank benches kept scrupuously clean for use of the men while eating their noonday lunches.

Method of carrying on work

Two series of hopper cars, principally being worked at the present time, are receiving all new side and end sheets. The cars are stripped on an outside track, all the top and bottom angles, side stakes, tie bars, etc., being placed in the cars which are then switched to the repair track. The cars move in at the west end of the shop and are handled through the shop by the progressive system, being turned out at the east end with painting and stenciling work done on an outside track.

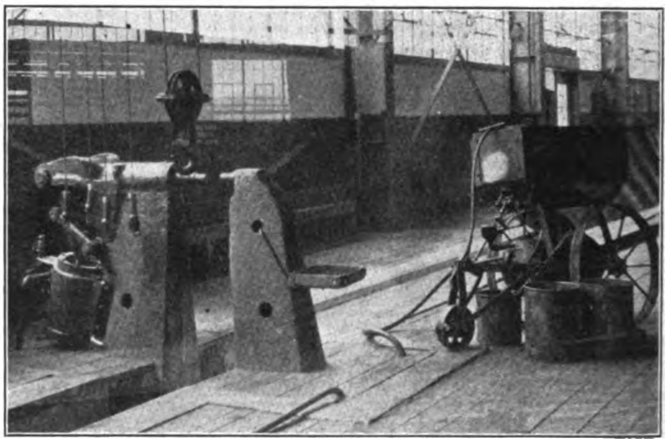
On arrival in the shop all bent angles, stakes, tie bars, etc., are removed from the cars and taken to the straightening furnace or fitting-up bench. Steel coal car side sheets, posts and angles are assembled on trestles and then taken with the traveling crane to the riveting pit where the unit is handled by an electric crane built over the pit. The entire coal car steel side sheets are riveted. The traveling crane then takes the entire side to the car where it is placed in position and the remaining rivets applied.

On steel and single sheathed box cars, the side sills, side plates, side posts and braces are assembled in a jig on special trestles with rollers designed to receive this jig. The riveting of the side frame is done by the portable Hanna riveter and the frame is then placed in position on the car by the traveling crane. The purpose of the jig used in riveting all large parts of steel equipment is to keep each sheet square so there will be no question about

Assembly jig mounted on special trestles with rollers and used for alining side frames—Rivets are driven by a portable Hanna riveter hung from post crane in background

fitting or loss of time when the frames are applied to the cars.

The handling and repairing of steel cars and steel parts is being done in the shop at a great saving over the old method of performing this work in the open with practically no facilities. In repairing cars in the open without any shelter, all material had to be handled by hand and also applied to the cars by hand. Scaffolds had to be built around each car and practically all the riveting and reaming done from these scaffolds. In the new shop, per-



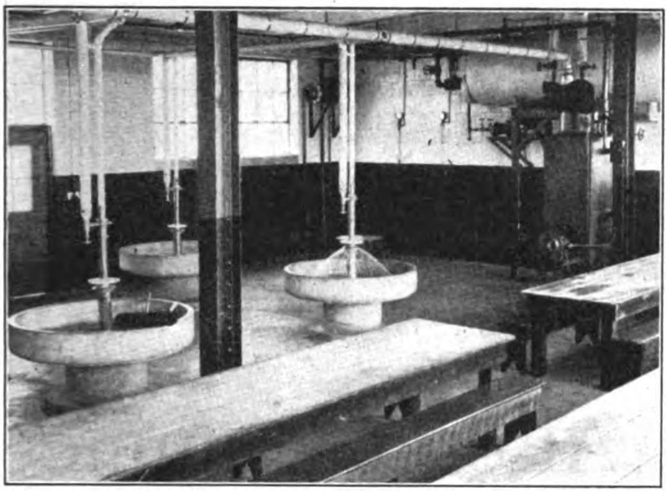
Hanna 70-ton gap riveter and section of 110-ft. pit used in riveting car sides

manent scaffolds, crane service and electric truck service take the place of hand work formerly done on the outside tracks.

At the present time the steel car repair force consists of 54 men, namely, 36 steel car repairers, 12 helpers, 5 laborers and an overhead crane operator. Seven of these men are being used for stripping the car parts that have to be renewed. After this work is done on the outside of the car repair shop, the scrap material is handled and loaded by a crane into cars ready for shipment. Twelve men work the trucks, draft gears, air brakes, brake rigging and adjust hopper doors. Six men are used in fitting up side sheets and reaming holes, getting side sheets ready

for the power riveter. This power riveter is manned by 5 men, 2 car men and 3 helpers. Three men are on the straightening fire, straightening top and bottom angles, side stakes, etc. Two men are assigned to handling finished side sheets from the riveting pit to cars with the overhead crane. Enough bolts are placed in these side sheets to hold them in place for the fitting and riveting gang which finishes the car. Twelve men do all the fitting, reaming and riveting at the car. Five laborers are assigned to bringing in material, taking side sheets from the riveting pit to the car and cleaning up the shop.

This force of men turned out 39 hopper cars the first 15 working days that the new shop had been in operation,



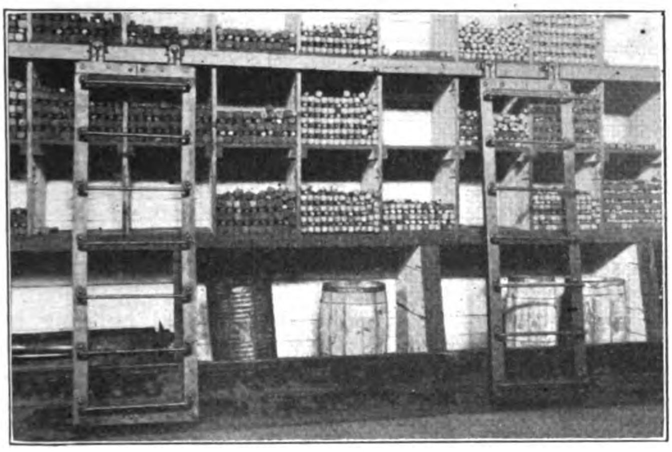
The locker, wash and lunch room is kept scrupulously clean

and this figure has been increased as the men became more familiar with the new method of working these cars.

Switching at the shop is done with a switch engine, the cars being classified before going in the shop so that the tracks, as a whole, can be finished at about the same time and thereby not cause any delay to finished cars moving out.

Sliding ladder for stock bins

When the bins in a stock section are higher than a man can reach, it is obvious that a ladder must be used. Often a ladder is not available in the immediate



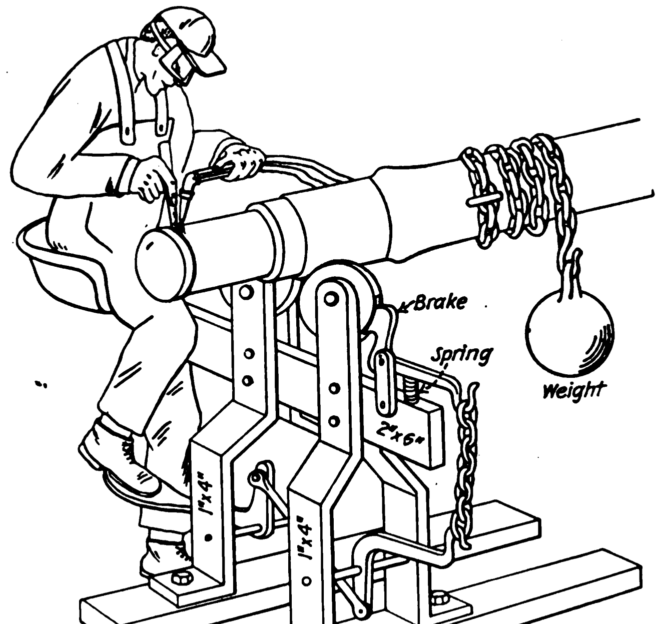
Ruggedly built stock section ladders which traverse on box car door hangers

vicinity with the result that much time is lost before one is located. This condition was found to be true in the storehouse located at the Secaucus, N. J., car repair yards of the Delaware, Lackawanna & Western. As can be seen from the accompanying illustration, ruggedly built, sliding ladders are now a permanent auxiliary to the stock sections.

The ladders are supported by two standard box car door hangers which run on a 1¾-in. by 1¾-in. by 1¼-in. Z-bar rail. The sides of the ladders are made of 2½-in. by 2½-in. angles to which are riveted seven standard box car ladder treads. The lower end of the ladder does not slide along the floor but is about 2 in, from the floor and slides along an angle iron which is secured to the top of the stock section base-board. This feature is an improvement over the common practice of the bottom of the ladder running on rollers which would not pass over nuts, bolts or any other material that may happen to be on the floor. The ladders can be moved with little effort.

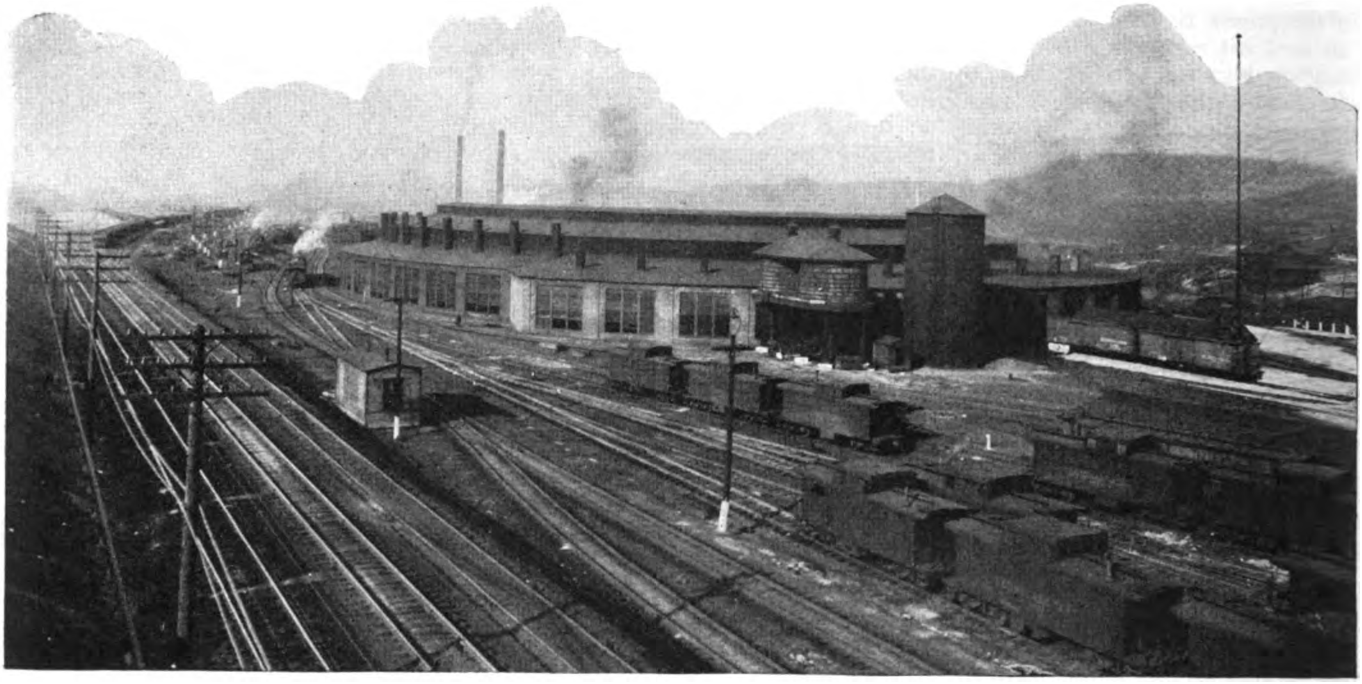
Device for turning car axles when welding collars

If the proper facilities are not provided, it is difficult to turn a heavy axle when building up a worn collar by the gas welding process. In order to obtain the best results the metal must be put on without any interruptions. For the operator to do this, the axle must be arranged so that he can turn it with ease, which can be done with the



A device which enables the welder to control the rotation of the axle with his foot

arrangement shown in the illustration. Each end of the axle rests on two rollers each held between two 1-in. by 4-in. plates securely bolted to wooden beams. To one end of a 2-in. by 6-in. iron plate is attached a seat for the operator. Under the seat is located a foot pedal which operates a series of levers attached to one of the rollers which acts as a brake. A chain is wrapped several times around the axle to which is attached a weight. When the welder wants to turn the axle, he releases the brake, which allows the weight on the end of the chain to pull the axle around to working position.



The East Altoona enginehouse showing the section of the house in which 18 stalls have been lengthened 30 ft.

Pennsylvania East Altoona engine terminal

Over 200 freight locomotives turned daily—Has shop facilities for heavy running repairs

Part I

A FEW miles east of the corporate limits of Altoona, Pa., is located the East Altoona freight engine terminal, the largest on the Pennsylvania Railroad and reputed to be the largest on the American continent. It covers 57.2 acres.

During the month of December, 1925, with a total working force of 1,134 men, 6,472 locomotives passed over the four inspection pits, 7,239 fires were cleaned, 118,139,500 lb. of coal and 2,192,720 lb. of sand were handled at the coal wharf. Power was furnished for 1,656 east bound trains and 2,221 west bound trains. The number of locomotives receiving boiler wash certificates was 206. A total of 7,654, or a daily average of 246 locomotives were dispatched during the month.

These engines, of Santa Fe, Decapod, Mikado and Consolidation types, ran into the East Altoona terminal from eight divisions. These divisions which are grouped in the lower section of western Pennsylvania between Harrisburg, Pa., and Pittsburgh, include the Pittsburgh, Monongahela and Conemaugh divisions which constitute all of the Western Pennsylvania Grand Division of the Central Region; the Middle, Tyrone and Cresson divisions which are three of the five divisions making up the Eastern Pennsylvania Grand Division of the Eastern Region and the Williamsport and Elmira divisions two of the four divisions of the Central Pennsylvania Grand Division also a part of the Eastern Region. A study of the accompanying map of these eight divisions shows that the East Altoona terminal is centrally located with respect to the territory which it serves.

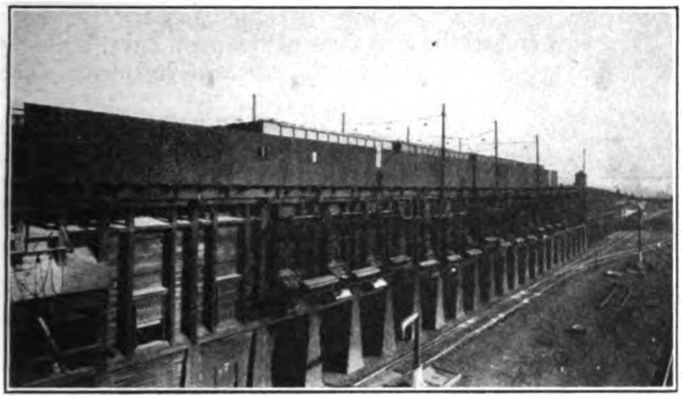
Inspection and ash pits and coal trestle

The four inspection pits, two on each side of the coal wharf trestle, are located at the west end of the terminal layout. These tracks are 90 ft. long and are provided with concrete pits. The main inspection pit service building, which is two stories, 42 ft. 9 in. by 10 ft. 6 in., is located along the north side of the inspection pits. This building is used by the supervisory force and by the inspectors and enginemen to make out their work reports. One terminal of the pneumatic tube used for sending the work reports to the enginehouse office is located in this building. A telephone is also located here for communication to various points in the terminal layout. Under the trestle of the coal wharf approach is located a smaller inspectors' building and a material building in which is kept a complete stock of small material and engine supplies. A list of all the material in stock is posted in this building. Also located under the approach to the coal wharf is the apparatus for mixing the oil and water used for cleaning the locomotives before they are placed on the pits. Oil faucets from which lubricating oil, signal oil and kerosene are drawn, are located outside of the east end of the main service building.

The four parallel water ash pits, 240 ft. long and 4 ft. 6 in. deep are located, two on each side of the coal wharf

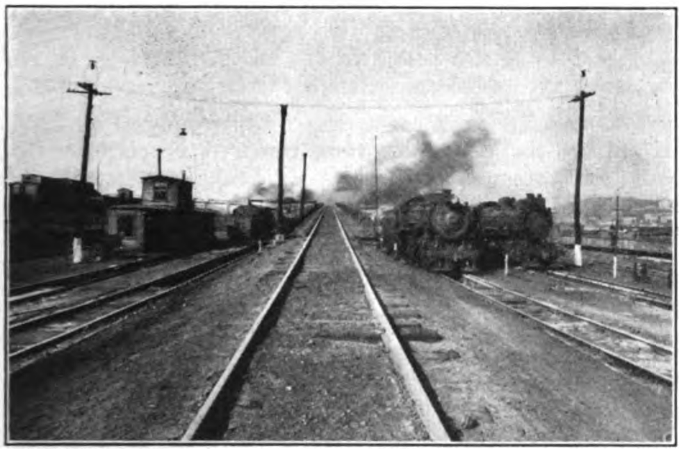
trestle. A cinder car track is located between each group of two ash pits. A five-ton capacity traveling crane is located over each pair of ash pits and their cinder track. The pits are cleaned out by means of a clam shell bucket. Five hydrants are located to serve each pair of ash pits. A service building, 22-ft. 6-in. square, is located under the coal wharf trestle for the use of the staybolt inspectors and ash pit men.

The 1,200-ton capacity coal wharf is of the wooden tipple design with 30 coal chutes, 15 on each side. A



This trestle has a capacity of 1,200 tons of coal and 2,500 tons of sand

storage capacity for 2,500 tons of wet sand is available underneath the wharf and the trestle approach. The sand is dried by steam in a steel box approximately 12 ft. long, 5 ft. wide and 3 ft. deep, equipped with three staggered rows of steam coils. The sand is conveyed to the steam coils by a conveyor system, and as it dries, sifts through two screens, one of which is ¼-in. mesh and the other 1/16-in. mesh. The sand then passes into a tank from where it is elevated by air into a large storage tank located on top of the wharf. A sufficient supply of sand is dried



Looking up the coal trestle approach on each side of which are two inspection pits

by one laborer in eight hours to last for the remaining 16 hours.

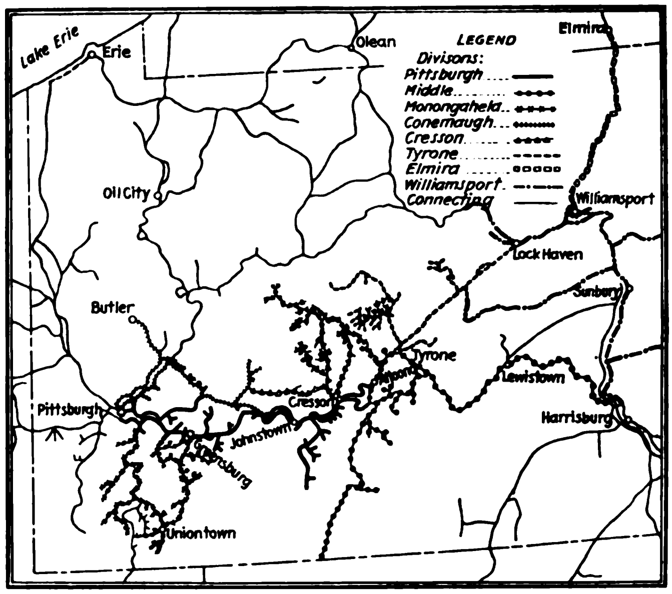
The west bound cabin storage tracks are located along the north side and the east bound along the south side of the coal wharf.

The enginehouse

The enginehouse is a complete circle containing 50 stalls, and a run-through track all of which is served by a 100-ft. turntable. When the enginehouse was first built, the 90-ft. stalls were long enough to hold the largest locomotive then in service on the Pennsylvania with sufficient allowance for larger locomotives of the Consolidation type. With the advent of the Mikado type, the capacity was reached and when the Pennsylvania built its Decapod locomotives, the 90-ft. stalls were not sufficient to hold a Decapod locomotive and at the same time be able to close the circle doors or to spot the locomotive at any point on the wheel circumference for rod work, etc. As a result of these conditions, work was started in August, 1925, to lengthen 18 stalls, 30 ft.

The work required the removal and rebuilding of the old walls, roofs, etc., together with the moving of a 183,000-gal. water tank, 30 ft. and the relocation of several tracks. The jacking walls of the new pits were built 2 ft. 7 in. wide and 35 ft. 9 in. long, the purpose being to reduce to a minimum the damage to the enginehouse floor through the use of jacks. The new pits, as well as the old ones, are equipped with a blow-off system connected to the sewer.

A two-ton jib crane has been installed near the front



Map showing the eight divisions from which the power enters East Altoona freight terminal

end of each of the 18 long tracks and this, in addition to the present one-ton jib cranes now in place, will permit the use of four cranes around each locomotive.

The enginehouse, as it now stands, has 18 stalls, 120 ft. long and 32 stalls 90 ft. long. The outside radius of the enlarged portion is 228 ft. 3 in. and the remainder, 198 ft. 3 in.

The four electric drop tables used for dropping driving, engine truck, trailer and tender wheels are located in the pits facing the wheel storage yard and machine shop. There is one 24 ft. drop table and one 55 ft. drop table on which all the driving or tender truck wheels can be dropped at one time, and two 8-ft., double-end tables for handling trailers and single pairs of driving wheels.

Convenient offices for the supervision are located throughout the house. In addition, there is a large office for the boiler and machinery inspectors and the assistant enginehouse foreman.

Machine and blacksmith shop

The machine shop, blacksmith shop and circulating tool room are located in a building 70 ft. by 162 ft. 9 in. Table I is a list of the machine tool equipment in the machine

shop which makes it possible to refit main and side rods, make all wheel repairs and handle other work, such as driving boxes, which in many large terminals are handled in an adjacent back shop. In addition, air brake equipment, injectors, steam gages and other similar parts are repaired and tested. A fully supplied and well maintained tool room is located at the southwest corner of the machine shop. During the first trick three machinists are engaged in the tool room making repairs on hydraulic jacks, oil furnaces, air tools and other small tools. The duplicate brass check system is used for checking out tools.

The blacksmith shop is located at the eastern end of the machine shop building. It contains two steam hammers, four forge fires, one oil furnace, one babbitting furnace for crossheads, one copper brazing forge fire and one electric welding outfit. A corner of this shop is set apart for repairing electric headlights.

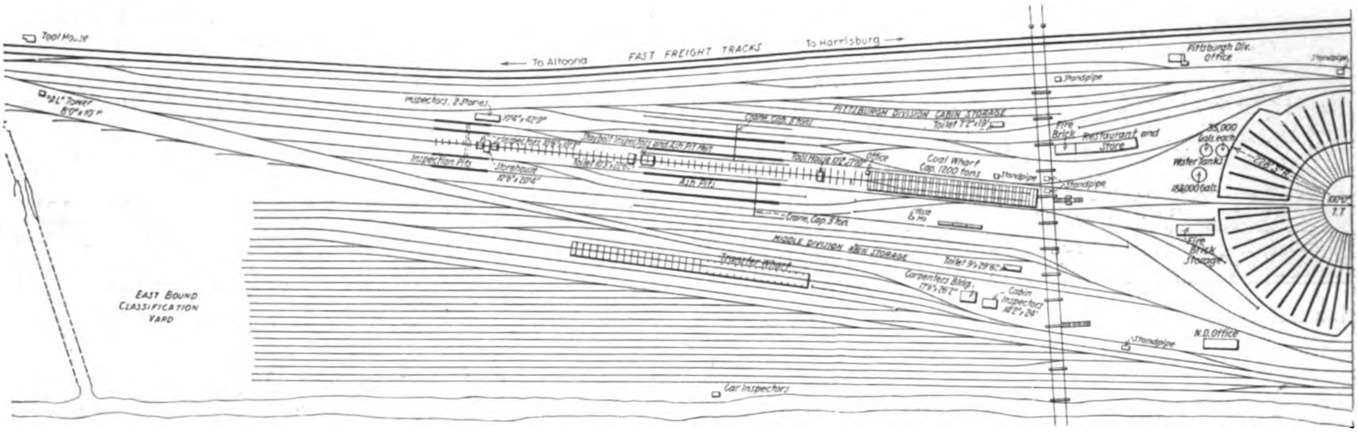
Outside at the east end of the machine shop is located a 19-ft. 6-in. by 35-ft. building in which headlight turbine generator sets are repaired and a building 10 ft. 8 in. by 26 ft. 10 in., is also here provided for tin repair work.

The main office building

The main office building, which is parallel to the south side of the machine shop building, is of brick construction, 161 ft. by 65 ft., two stories high. Part of the first floor is taken up with the offices of the assistant master mechanic, the general foreman, two engine dispatchers' offices (one for west bound and one for east bound power), a work chart office where the piecework charts are copied from the work reports received by pneumatic tube from the inspection pits, and the piece work chart office where the charts are prorated.

The personnel for each trick in the westbound dispatcher's office consists of two dispatchers, one work distributor and a clerk. In the east bound dispatcher's office are one dispatcher, one work distributor and one clerk. The duties of the work distributor are to check the locomotive work reports after they come from the inspection pit, take these reports to the locomotives and examine the defects reported, decide on how the work is to be done and furnish to the engine dispatchers an estimated time at which the locomotives can be ordered for service. The dispatchers notify the foremen on the storage sidings what locomotives must be ready for service at various designated times. There are also two assistant road foremen's offices on the first floor of the main office.

The second floor of the main office building is taken up with engine crews' bunk rooms, recreation and reading rooms and a fully equipped air brake instruction room. The equipment in this room consists of a boiler head fitted complete with the various brake equipments in use on the road, together with all the other appliances found on the boiler head of a locomotive. There is also a test rack fitted with 11 operating sets of car brakes, with additional brake pipe volume to represent an 80-car train. The room also contains cut sections or charts of practically all the parts of the air brake equipment used on the Pennsylvania Railroad together with cut sections of other locomotive appliances such as a whistle, safety valve, steam heat valve. etc.



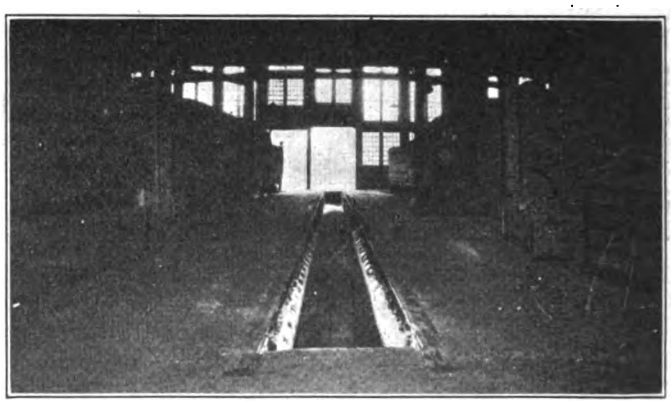
The western end of the terminal showing the inspection pits and coal wharf

The stores department

The east end of the first floor of the main office building and the basement is used by the stores department. The first floor area is 96½ ft. long and 65 ft. wide and the basement, 128½ ft. long by 65 ft. wide. The stock contains 8,800 items. The number of stores department employees for each trick is shown in the following table:

	Tricks 1	2	3
Stockmen	2	1	0
Clerks	1	0	0
Store attendants	11	5	3
Laborers	9	0	0
Total	23	6	3

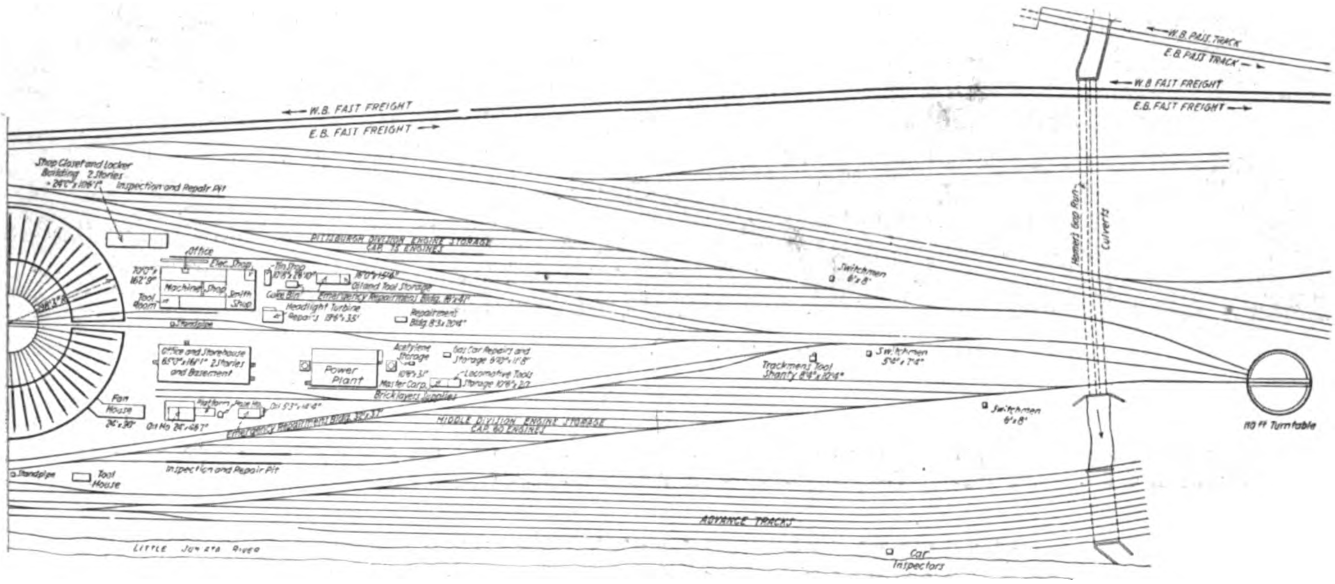
The stores department carries a full supply of all kinds of finished main and side rods, repaired air compressors, crossheads, pistons, injectors, air brake equipment and all other parts necessary for the repairs of the various classes of locomotives handled at this terminal. A full line of parts for the maintenance of feedwater heaters, power reverse gears and stokers is kept in a separate room.



A view of one of the lengthened stalls—At the right may be seen one of the material stock bin sections

This section is well arranged and is helpful in making quick repairs to these auxiliaries.

About 5 supply cars, which come from the Altoona machine shops are handled every day by the stores department. The material brought by these cars is ordered the day before. The back shops co-operate fully with the enginehouse and give it preference when distributing material. In case the enginehouse is in need of any material in a hurry, the order is telephoned to the Altoona back shops with the result that the material is brought to East Altoona from the main storehouse by an automobile truck. An in which it is located, is placed on one end o fthe section under glass. In the morning, a stores attendant visits each section. He makes a list of the material needed and issues orders for it. In the afternoon, a stores attendant and a laborer, with an electric truck, delivers the required material to the bin sections. If any material is not furnished by the stores department, the gang foreman in whose territory the stock section is located, makes a list of the missing items and sends it to the general foreman. The latter personally checks the lists with the storekeeper in order to obtain the material needed. This system of



The eastern end of the terminal layout showing the locomotive storage tracks and lower 100-ft. turntable

average of about $110,000 worth of material is consumed every month at the East Altoona terminal, of which $3,500 is used at the inspection pits.

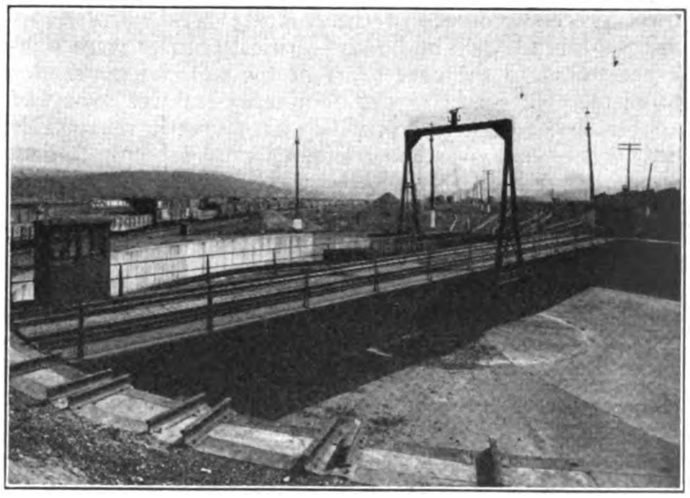
A large bin section for stocks of small material is located at the inspection pits. There is a smaller section at each of the two locomotive storage sidings and there are 10 such sections at various points in the enginehouse. A typewritten list of the material carried in each section, giving the amount of each item and the number of the bin

Table I—The machine tools located in the machine shop of the East Altoona engine terminal

Number	Description of machines
1	42-in. vertical turret lathe
1	27-in. by 17-ft. engine lathe
1	20-in. by 16-ft. engine lathe
1	30-in. by 8-ft. engine lathe
1	20-in. by 8-ft. engine lathe
1	24-in. by 6-ft. engine lathe
1	16-in. by 8-ft. engine lathe
1	Journal lathe
1	21-in. slotter
1	Duplex rod boring mill
1	10-in. by 36-in. plain grinder
1	36-in. emery grinder
1	10-in. emery grinder
1	6-in. floor grinder
1	Drill and reamer grinder
1	2-in. bolt cutter
1	1-in. to 6-in. pipe threader and cutter
1	79-in. wheel lathe
2	24-in. shapers
1	32-in. crank planer
1	36-in. by 30-in. by 10-ft. planer
1	21-in. vertical drill
1	4-ft. radial drill
1	6-in. bench drill
1	Horizontal, boring milling and drilling machine
1	100-ton hydraulic press
1	7-ton bushing press
1	7½-ton overhead traveling crane
1	Brake valve test rack
1	Pump governor test rack
1	Air safety valve test rack
1	Distributing valve test rack
1	Injector test rack
1	Superheater damper cylinder test rack

keeping the stock bins filled is effective, as the undivided responsibility is placed directly on the stores department.

The oil house is in a separate building along the south side of the main office building. In it are kept all necessary oils, sponging and waste used about an engine



The 110-ft. turntable located at the eastern end of the terminal layout

terminal. The oil cars coming directly from the main oil mixing plant located at South Altoona, are placed over the intake pipes and are discharged directly into the large supply tanks located underneath the ground from which the oil is forced through the faucets under pressure.

(To be concluded next month.)

Santa Fe apprentices who attended the convention at La Junta, Colorado

Santa Fe apprentices hold third annual convention

Over two-hundred present from ten states and twenty-nine clubs

PUBLICATION of the report of this meeting, which was held at La Junta, Colo., February 22-26, was purposely delayed until this time. In the three preceding issues of the *Railway Mechanical Engineer*—March, April and May—critical articles were published going to the very heart of the railroad apprentice problem. Here is a report of a representative group of apprentices from a system which has shown a remarkable degree of confidence in developing a modern, up-to-date apprentice system—and it believes in it and its officers can tell why in no uncertain terms. This brief résumé of the proceedings of the meeting of these young men, studied in connection with the three articles above-mentioned, may be illuminating to those who are skeptical about the advantages and necessity of apprentice training.

During the past three years several conferences of younger men engaged in railway service have been held, chief among them being the Railroad Y. M. C. A. conferences at St. Louis (1923), Detroit (1924) and Pittsburgh (1925) and those conducted in 1925 and 1926 by the Chesapeake & Ohio at Huntington, W. Va. These conferences promise to mark a new era in the selection and training of young men for railway service and in inspiring them to become better citizens.

Three somewhat similar annual conventions, held by the apprentices of the Santa Fe, have proved equally inspiring and effective, although they have been restricted to mechanical department employees and to apprentices only. The first of these was held at Albuquerque, New Mexico, in 1924, the second at San Bernardino, California, in 1925, and the third at La Junta, Colorado, last February.

Conference and basket ball tournament

The Santa Fe apprentices, in a unique manner, combined a convention proper with a system basket-ball tournament. Regular convention sessions were held each forenoon and early afternoon, to listen to addresses given by railway officers and others, with general and group discussions of matters of interest to the apprentices. The basket-ball games were confined to the late afternoon or evening hours and no one was permitted to play in the tournament who did not attend the sessions of the convention. Each apprentice club on the system was entitled to send four voting delegates to the convention and to enter a basket-ball team in the tournament. No apprentice was eligible to attend who was not up to the required standard in his apprentice school classes or shop work.

These apprentice conventions are held with the approval and guidance of the Santa Fe management but conducted by the apprentices themselves. The company furnishes necessary transportation and leave of absence to those who are selected as delegates. The apprentices pay their own expenses, except where these are paid by their local clubs, shop craft associations, or from money raised locally by entertainments or by athletic carnivals. Lodging and breakfast is furnished by the citizens of the community in which the convention is held, the local chamber of commerce aiding the local apprentice club in the arrangements for the convention. The daily papers give prominent mention of the proceedings of the convention. At this convention, the La Junta *Daily Democrat* contained a double page welcome from the merchants of the city. The *Tribune* devoted one entire issue to the proceedings.

It was interesting to note that in this large gathering of boys from so many widely scattered localities, not one case of disorderly or unbecoming conduct was reported, the daily papers on the contrary remarking on the fine appearance and gentlemanly conduct of those attending the convention. They represented the cream of the apprentices of a road which has exercised great care in the selection of its apprentices and which because of the thorough training and other opportunities offered its apprentices and apprentice graduates has attracted the finest young men of the communities which it serves. It was a wonderful gathering. At one time five division master mechanics of the road were in the convention, four of whom were themselves products of the present Santa Fe apprentice system, their presence and remarks being a great inspiration to the apprentices and a convincing illustration of the opportunities for promotion open to those who prove worthy.

There were in attendance 205 apprentices from all over the Santa Fe system, coming from 10 different states and representing 29 apprentice clubs. As one speaker said, there were Santa Fe apprentices present not only from Topeka, known as the "holy city" of the Santa Fe, and from Kansas City which the radio announcer proclaims as the "heart of America," but from the far off pine groves of Silsbee, Texas, to the orange groves of sunny California; from the windy city, Chicago, to San Francisco at the Golden Gate. There were also present as guests a delegate from the apprentice club of the Missouri-Kansas-Texas at Parsons and two from the club of the Kansas City Southern at Pittsburg, Kan., on both of which roads the supervisor of apprentices is a former Santa Fe apprentice.

Sixteen basket-ball teams were entered in the tournament representing the following clubs: Winslow, Arizona; Las Vegas, New Mexico; Raton, New Mexico; Temple, Texas; Wellington, Kansas; Pueblo, Colorado; Fort Madison, Iowa; Dodge City, Kansas; Clovis, New Mexico; Arkansas City, Kansas; Newton, Kansas; Albuquerque, New Mexico; San Bernardino, California; Topeka, Kansas; Richmond, California; and La Junta, Colorado. The boys played good basket-ball, many of them having been former stars on their high school or college teams. They played hard and fast, exhibiting true sportsmanship in playing the game square that the best team might win. The various club and state yells resounded throughout the contest. Kansas proved to have the best teams, all four teams going into the semi-finals being from the sunflower state. The tournament was finally won by the team from Newton, Kansas, after a spirited contest with the team from Wellington. Suitable trophies were awarded the winning team with a silver basket-ball charm for each of the individual players on the all-star team of the tournament as picked by the referees and judges.

The convention opened on Washington's birthday with an invocation by Rev. C. W. Halsey, and with the singing of America. C. Leroy Coleman, an apprentice at La Junta and president of the Association of Santa Fe Apprentice Clubs, presided throughout the convention, and in a manner that would have been creditable in any civic organization. Addresses of welcome were given by the mayor and the president and secretary of the Chamber of Commerce. Responses to the addresses of welcome were made by delegates from the various clubs. Greetings were read from John Purcell, assistant to the vice-president and chief of the mechanical department, and other officials of the company. F. W. Thomas, supervisor of apprentices

The La Junta Chamber of Commerce made a public display of Santa Fe apprentice trophies, lesson sheets and materials

was present adding pep to the meeting and assisting where opportunity presented.

Pays to train apprentices

One of the best addresses of the convention was given by J. R. Sexton, mechanical superintendent, on the subject of "Why It Pays to Train Apprentices." He contrasted the opportunities given him while learning his trade with those offered today to the apprentices on the Santa Fe, and gave nine reasons for training apprentices. Among these are: It pays any road to train its own men; it provides a training for foremen, 95 per cent of the foremen on his district having been trained as apprentices on the Santa Fe; labor turnover is reduced as the men stay with the road that has trained them; it aids in meeting extraordinary conditions, since the apprentices can be used as a flying squadron in emergencies.

John H. Linn of the apprentice department stressed the importance of the railroad industry and of railroading as a life-calling, pointing out that it is due to the railways that the vast material resources of this country have been developed and that our people have been brought closer together and cemented into a great nation. He told of the attention given by the railroads to the selection and improvement of materials and of the even greater necessity of the selection, placement and training of the human element.

G. M. Lawler, division master mechanic at La Junta and a graduate Santa Fe apprentice, spoke on "The Opportunities for the Graduate Apprentice," pointing out the policy of the Santa Fe in promoting from its own ranks and giving concrete illustrations of Santa Fe graduates promoted. R. M. Tirey, city superintendent of schools, had for his subject "Sixteen Hours Off the Job. What Can I Do?" He allotted half of this time for sleep, half of the remaining time for meals and in getting to and from work, stating that what we eventually become depends on the use made of the four remaining hours.

Homer Hoisington, state secretary of the Y. M. C. A. for Colorado, spoke on the topic, "As an Individual What Can I Do To Become a Better Citizen?" He held up a high standard of living and urged the boys to go into athletics both for the physical benefit they will derive and for the benefit to their characters that would come from true sportsmanship. A sound body, a clean mind, clean friendships, and a Christian character are all needed to make up a fully rounded man.

R. S. Johnston, surgeon in charge of the local Santa Fe hospital spoke on "Keeping Fit." The advice he gave coming from a man in his position made a deep impression on the minds of his young hearers. Judge M. F. Miller in a patriotic address gave the delegates, "Something to Think about on the Way Home," urging obedience to the constitution and the laws of the land, respect for the flag and the principles for which it stands, and obedience to God.

There were talks also by Charles Siebrel, shop safety superintendent, and by L. F. Butler and Clyde Schaeffer, system officials of the Shop Crafts Association. One of the most interesting addresses of the convention was by an apprentice boy, R. B. Crowley of Las Vegas, N. M., who spoke on the "Training of Machinists and Apprentices for Supervisory Positions" in a manner that would have reflected great credit on any man in a supervising capacity.

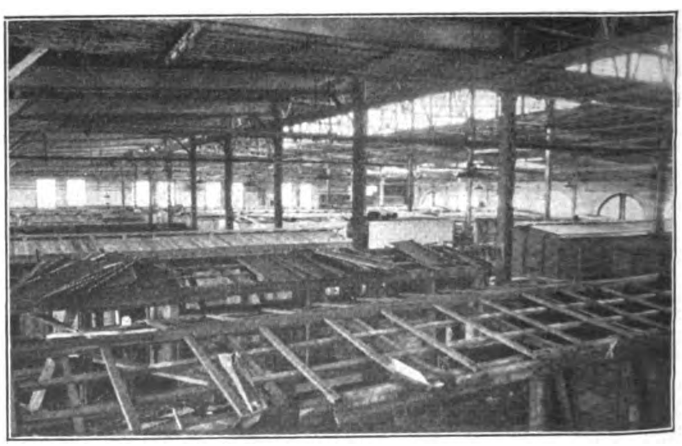
Activities of apprentice clubs

At different times during the convention, the apprentices broke up into groups and talked informally about the subjects discussed in the preceding formal addresses. These group discussions proved one of the most profitable features of the convention. Then there was a discussion under the leadership of E. B. Ralph, apprentice instructor, La Junta, of the activities of the various apprentice clubs represented. A delegate from each location answered the question, "Why We Have a Club At ....," "The Trouble With Our Club," "Our Difficulty in Organizing Our Club," "The Activities of Our Club," etc. This discussion proved most helpful, the weaker clubs profiting by the experiences of those which had been more successful. One of the clubs reported not only literary and social entertainments, and athletic events, but also the staging of plays, a real wild west rodeo, a big donation to help replace a church that had burned down; another a generous donation to a local hospital fund, not to mention a monthly newspaper of its own.

Mention should also be made of the convention banquet at the Harvey House, at which F. W. Thomas, supervisor of apprentices acted as toastmaster, and also of the Convention ball, and of the luncheons served each day by the ladies of the different churches, wherein the boys entered into a spirited competitive song fest, and good natured raillery, exhibiting unusual wit and characteristic pride. The singing at the opening of each session under the leadership of Loyd Larsen was exceptionally good, making the boys feel at home and putting them in a receptive mood.

The closing day was given to a sight-seeing or educational trip, the delegates being taken in special coaches to Pueblo, Colorado, where they were the guests of the Colorado Fuel & Iron Company. They were given an opportunity of witnessing and studying the process of converting crude ore and raw material into the finished product, of seeing the manufacture of steel in various forms used in railway service, from that of a very small finishing nail to a 110-pound rail. The various steps were thoroughly explained by competent and intelligent guides. The boys were given a luncheon provided by the C. F. & I. Company, at which the general superintendent of the plant presided.

An important factor, also, is the educational value of the opportunity given the delegates to these conventions to visit other shops of the road and become more familiar with the road as a whole. The different Santa Fe cities and towns vie with each other in bidding for the conventions. At one time at the recent convention a dozen or more telegrams were received from the chamber of commerce, the daily newspaper, the superintendent of schools, the hardware merchant, the banker, and other leading men of one of the cities asking for the convention next year. Wellington, Kansas, was selected as the place for next year's meeting.



Interior view of the box car shop, Lehigh Valley, Sayre, Pa.

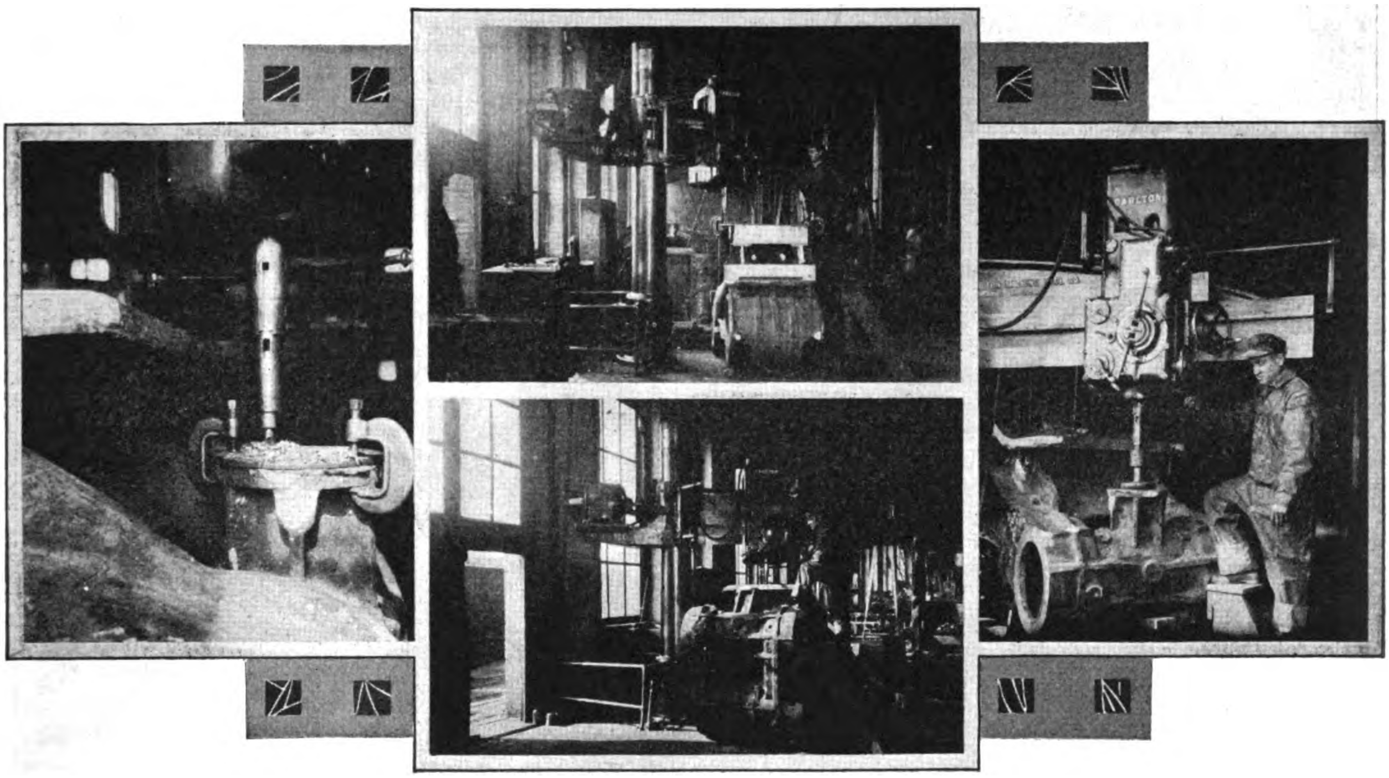
The drilling machine in the railway shop

Requirements for efficient operation—Jigs fixtures and practical set-ups

By L. R. Gurley

According to an old analysis, which probably holds approximately under present conditions, 17 per cent of the machine operations in railroad shops are drilling operations. This work is handled on three types of machines; namely, the sensitive or bench drill, the vertical drill and the radial drill. There is a tendency among machine shop foremen to consider the drilling machine as a handy machine to drill holes which can be operated by any workman who knows how to start and stop it. The foreman often gives most of his attention to increasing the efficiency of the other supposedly more complicated and important machines and gives the drilling machine little attention. Attention given to the improvement of the efficiency of drilling operations will be profitable, however, because of the large variety and volume of drilling work handled in a railroad shop.

Many drilling machines at present used in railroad shops and engine terminals have unquestionably outlived their period of effective usefulness. In some cases the driving motor is too small, or the driving pulley and belt does not transmit sufficient power to operate the machine at the desired cutting feeds and speeds. In other cases the clutches and gear shift mechanism for transmitting power within the machine itself are inadequate for present-day needs. Sometimes the spindle bearings are worn, or in the case of radial machines, the head bearings on the radial arm are worn beyond the point where lost motion can be taken up, with the result that the drill spindle wabbles "like a drunken sailor." Under such conditions it is obvious that the desired results in the production of drilled holes cannot be obtained. There is only one effective remedy in such cases and that is to replace the weak or worn out machines with modern high-power drills, not forgetting that the requirements for railroad shop drilling machines are: First, adequate power for the job in hand; second, rugged design and construction to withstand the stresses encountered in this class of heavy duty work; third, convenience of starting and stopping and changing from one feed and speed to another in order to conserve the operator's time and provide increased production.



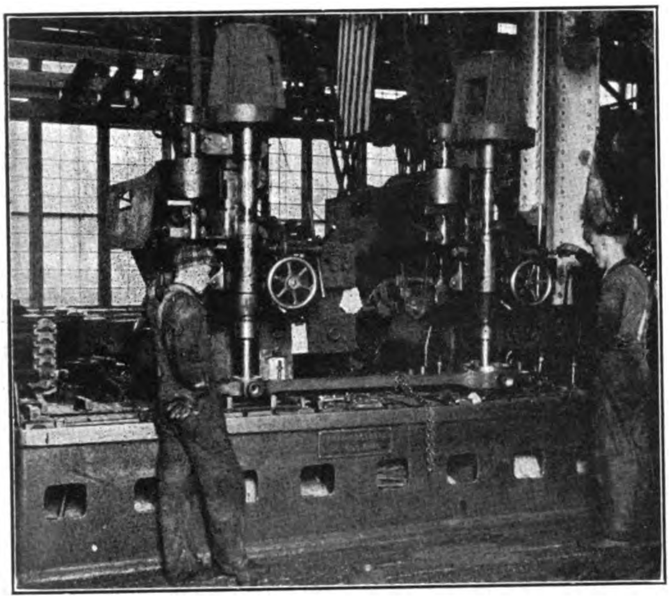
Drilling and tapping 180 holes and completing all reaming in on a new locomotive cylinder in 12 hours

Methods of training operators

Besides providing better equipment, shop managements can improve their drilling production by the education of operators as to what the modern drill can and should produce in the way of drilled holes. The range of work usually handled on a railroad shop drilling machine requires more or less variance in methods. For this reason the training of an operator must be approached from a different angle than is the case in a manufacturing plant where

the duties of an operator on a drilling machine are purely repetitive.

Experience has shown that it is profitable first to teach an operator to handle the simpler operations on the drilling machine, such as drilling cotter holes, oil holes, and work of a similar nature. On this class of work errors on the part of the operator do not necessarily result in spoiled work. As the operator becomes familiarized with the



A double head drilling machine on which from eight to ten sets of side rod bushings are completed in eight hours

actual cutting of the drill as used in the simpler type of machine as, for example, the sensitive drill or upright machine, he may be promoted to work requiring more accurate location of the holes, such as drilling work within circles scribed on the surface. He will thus become familiar with "drawing" the hole to the proper location and acquire habits of accuracy. Work involving the use of reamers and taps serves further to educate the operator in the care of tools, in the operation of more complicated machines and in the handling of more accurate work. By a succession of such stages the operator becomes fitted to handle more complex drilling machines, such as the large radials or special purpose machines. Machines requiring the use of boring bars or sizing tools, which must be adjusted by the operator, require practically the same skill in their handling as is required for certain lathe, planer or boring mill jobs.

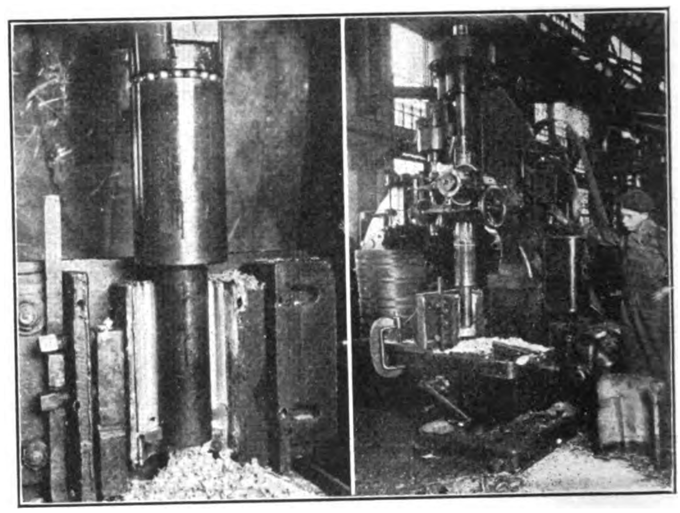
It is usually necessary to have the operator properly educated in drill grinding. This does not mean that drills may be ground by hand to give as good results as those ground in a drill grinding machine. On the other hand, unless the user of a tool knows what the condition of the tool should be, his proficiency as an operator is likely to be impaired.

Among the more important subjects with which the drilling machine operator must be familiar is the proper type of drills or tools that he may require in his work. For example, flat drills in comparatively thin pieces of brass or bronze will give very satisfactory results, while they are not so well suited for wrought iron or steel. The same principles applying to the tools used on the lathe or planer apply to the cutting angle of the drill. The thickness of the drill point has an important bearing on the output of the drilling machine. The point of the drill does not cut freely. A reduction in the thickness of the drill point means a corresponding reduction in the power required to force the drill into the work. Thinning a drill point requires good judgment on the part of the operator. If he is not sufficiently skilled, or is not provided with the facilities for performing this work, he should at least be competent to judge whether or not the point of the drill is of the proper thickness as well as to judge by the feel of the drill when feeding it into the work by hand, whether or not the tool has sufficient clearance. He should also be able to judge by observing the condition of a drill in use whether overheating is due to improper grinding, insufficient or improper lubrication, excessive feed or too high speed.

Spindle and drill speeds

One of the most vexing problems with which the foreman has to deal is that of urging the operators to keep their machines speeded up. It is not unusual to find an operator using the same spindle and drill speeds all day, regardless of the size of drills or kind of materials he may be working on. One operator may be working on a lot of gray iron castings. At the beginning of the day he will be using the correct speeds, but suddenly hits a hard spot which results in a burnt drill. He gets a new drill and slows up his machine and will continue to drill at the reduced speed until he has finished the castings, presumably on the assumption that he may hit more hard spots.

Every machine should bear a plate containing the various spindle and drill speeds at which it should be operated and the operator should be constantly reminded to use that table. A table of drill speeds and feeds is at best only a recommendation or guide. The purpose is to give a general idea of what output should be expected under certain conditions. Speeds and feeds should be increased or decreased as operating conditions warrant. The foreman should teach the operator to observe the working of the drill, to note carefully the results of each change of speed or feed, to study various methods of setting up work, to

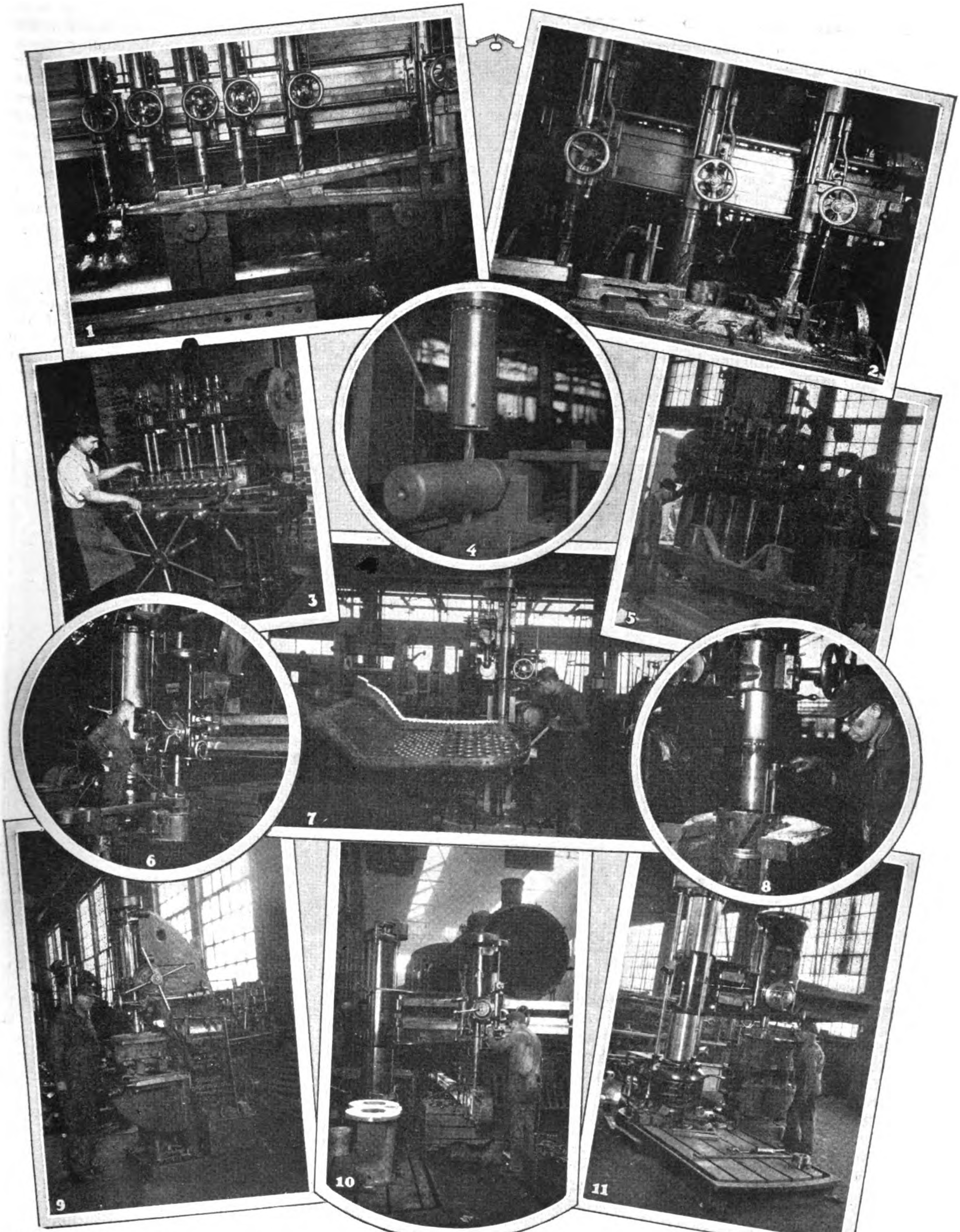


Boring to size engine truck brasses on a Foote-Burt drilling machine

detect variation in the materials drilled and to use good judgment at all times.

Several points must be considered in estimating time for any particular piece of work. These are the machines used, the method of setting up or securing the work, the type of drill, and the condition of its cutting edges. The last point is of the utmost importance. Regardless of the capacity of the machine or the fixtures used, it must always be borne in mind that the actual work is performed at the cutting edge of the drill.

The range of work required from railway shop drilling machines makes some machines of large capacity a neces-



(1) Drilling nine holes in a switch frog in 20 min. (2) Drilling three repair parts in a three-spindle machine—Note that all the work is held by air-operated clamps. (3) A six-spindle drilling machine on which 100 valve motion pins can be drilled at both ends in 8 hrs. (4) A vertical drilling machine used to cut a keyway in a piston rod. (5) Drilling four holes in an arch bar in 10 min. (6) Cutting the wristpin holes in both ends of a side rod in 2 hrs. 10 min. (7) Scarfing a back flue sheet in 6 hrs. (8) Cutting the grease grooves in a driving box shell in 20 min. (9) Boring and chamfering a driving box in 40 min. (10) Reaming a main rod strap complete in 1 hr. (11) Boring out the cylinder of an air compressor without taking it apart.

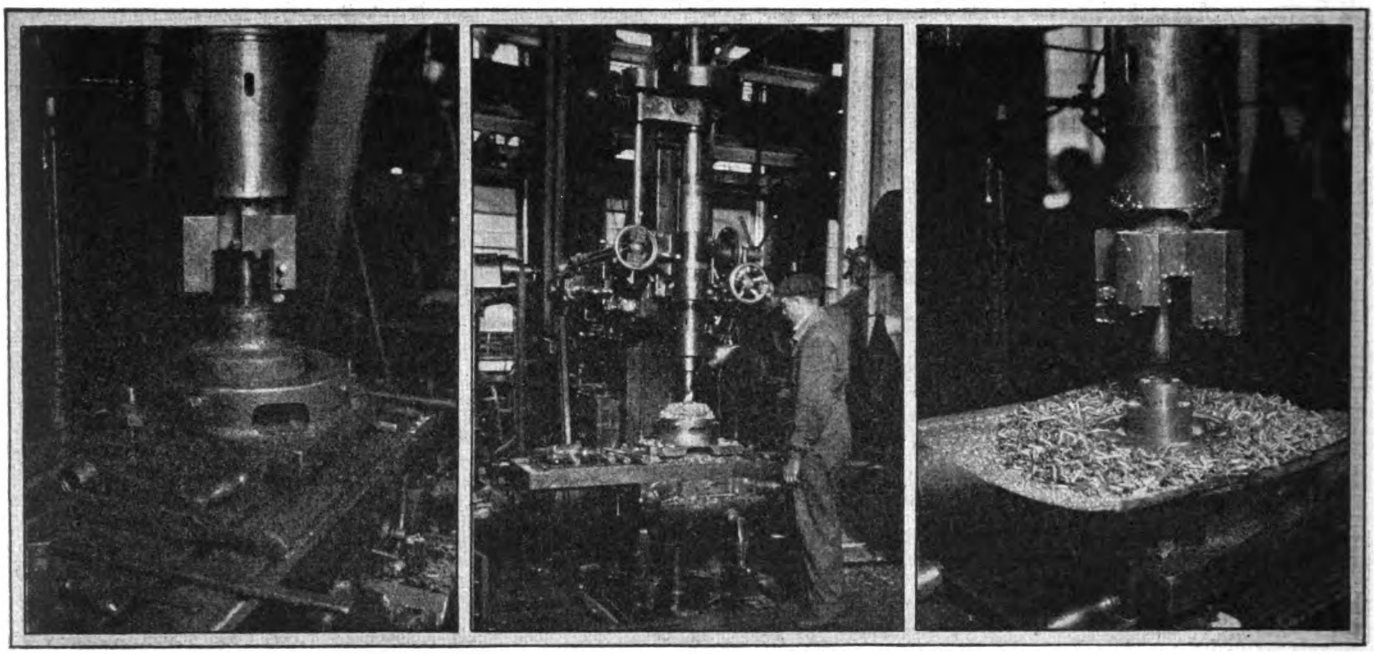
sity. One of the illustrations shows the comparative sizes of a modern locomotive cylinder and a heavy duty six-foot radial drilling machine.

Referring to this illustration, it will be seen that the cylinder being drilled is set close to the column of the machine rather than under the outer range of the arm. This rule should be observed in all drilling operations. On upright machines the results will be more satisfactory if the work is kept as near the center of the table as possible. This method avoids table deflection. Under normal conditions no perceptible spring is found in a well-built machine. Conditions other than normal, such as dullness of the drill, the drill slipping in the chuck, or carelessness in setting the work, may bring about a slight yielding that will react as the point of the drill passes through the lower side of the work. The action is similar to a sudden increase in feed and sometimes results in drill breakage.

Much valuable information has been published by the various twist drill manufacturers governing the proper selections of drilling speeds and feeds. This information should aid the foreman materially in obtaining the maximum production from his drilling machines, and every effort should be made to get it into the hands of the operators so that they will become proficient in their duties.

Very complete tables are compiled by the Morse Twist Drill & Machine Company, New Bedford, Mass., which contain information for the drilling of a variety of metals, most of which are commonly found in railroad shops. These tables, or others of a similar nature, should be in the hands of every operator. If no table is at hand and the operator is in doubt as to the correct speed for a twist drill, it is a safe rule to start carbon drills with a peripheral speed of 30 ft. per min. for soft tool and machinery steel, 35 to 50 ft. for cast iron, 60 to 120 ft. for brass, and a feed of .004 to .007 in. per revolution for drills ½ in. and smaller, and from .005 to .015 in. per revolution for drills larger than ½ in. At these speeds and feeds a good cutting compound is recommended when drilling steel. The so-called Mezzo drills, the characteristics of which lie between carbon and high speed drills, should be run at approximately double the feeds recommended for carbon drills. They should never be used in machinery steel containing over .35 per cent carbon, in hard alloy steel, chilled cast iron, or any other hard material. It is a safe rule to run high speed drills with a peripheral speed of 70 to 100 ft. per min. and a feed of .008 to .020 in per revolution in soft tool and machine steel, 70 to 150 ft. per min. and a feed of .004 to .008 in. per revolution in alloy steel, 200 to 300 ft. per min. and a feed of .015 to .020 in. per revolution in brass. This information, which is essentially the practice recommended by the Cleveland Twist Drill Company, is, no doubt, already in the hands of many readers of this article. It is so commonly neglected, however, in spite of its importance, that it will stand the repetition.

If the drill chips out at the cutting edge, there is too much feed or the drill has been ground with too much lip clearance. A drill split up the web is evidence of too much feed or of improper grinding. The failure to give sufficient lip clearance at the center of a drill will almost always cause it to split up the web. When the extreme outer corners of the cutting edges wear away too rapidly, it is evidence of too much speed. The best performance of a drill will be obtained when the effect of the work on the tool is somewhere between these two extremes.



Machining knuckle pins on a vertical spindle drilling machine—The view at the right shows the forming tool and the nature of the work it does

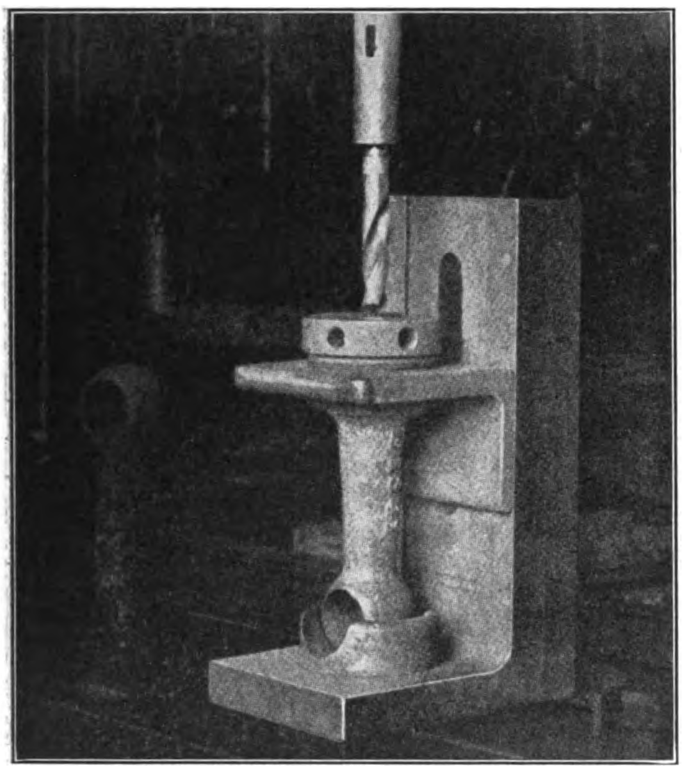
The remedy for properly ground drills chipping at the cutting edges is to decrease the feed and increase the speed. If a little care is taken to adjust these properly the drill will do as much work as before and have much longer life. If the correct speed is not obtained in drilling small holes with hand feed, the risk of breaking the drills is greatly increased, especially at the moment the point of the drill is breaking through the lower side of the work. This is due to the operator's difficulty in pressing lightly enough on the feeding lever not to give excessive feed to slow-running drills.

Variations in the hardness of the material drilled should, of course, be met by the skilled operator with changes in the speed and feed. This is necessary as the commercial twist drill must be tempered for average conditions so as to give good results in either hard or soft material. A drill that would give maximum results drill-

ing hard steel would be entirely too brittle to work well in softer and tougher material. To maintain the speeds and feeds recommended, it will be found necessary to use some good cutting compound. The following are recommended in the order named:

For hard and refractory steel	Turpentine, kerosene and soda water.
For soft steel and wrought iron	Lard oil, soda water.
For malleable iron	Soda water.
For brass	A flood of paraffine oil, if any.
For aluminum and soft alloys	Kerosene, soda water.
Cast iron	Should be worked dry or with a jet of compressed air for a cooling medium.

The above recommendations apply equally well to carbon or high speed drills, but it is good practice to warm the lubricant before using it with high speed tools. Any hard piece of steel is extremely brittle when cold, and high speed drills should never be put to work in that condition; they work much better when warm, often giving good results when the chips are blue. Nothing will "check" a high speed drill quicker than to turn a stream of cold water on it after it has become heated working in a hole. It is equally bad to plunge it into cold water after the point has been heated in grinding. Either of these practices



Drill jig for holding handrail columns

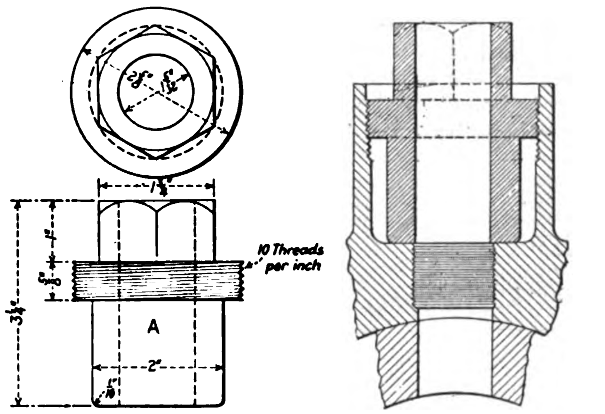
is certain to impair the strength of the drill by starting a number of small checks in it.

Grinding drills

The practice of grinding all twist drills on special grinding machines is quite general in railroad shops and it might seem that any comments on the advantages of this method are superfluous. Observations in some small shops, however, indicate that grinding by hand on ordinary stand grinders is by no means obsolete. Even in shops equipped with drill grinders mechanics often grind drills by hand to avoid making a trip to the toolroom to obtain a sharp drill. The desire to save time in this way is seldom effective. There are some skilled drill press operators who can do a very fair hand job of grinding drills, but they cannot consistently compete with the machine.

Twist drills will stand more load in proportion to their size than almost any other tool and a large percentage of drill troubles could be eliminated if proper attention were given to grinding the points. The form of the drill point controls the rate of production, accuracy of the hole, frequency of necessary grinding and the life of the drill. It has been observed that by pointing a drill properly the end pressure can be reduced about 60 per cent and the horsepower required to drive the drill by over 25 per cent.

Most twist drills are made with a gradual increase in the thickness of the web or center of the drill toward the shank. As the drill becomes shorter and the web thicker, greater force is required to drive it. To overcome this condition, it is good practice to thin the web to the original dimensions. The grinding must not extend too far up the flute of the drill and care must be exercised that the cutting lips are not injured; also that the same amount is



Jig used in drilling bushing grease plug holes

ground out of each groove. When the grinding is excessive, the web is left too thin and is liable to crumble. When this happens, a split drill is practically inevitable. Incorrect grinding is usually the cause of drills splitting up the center, and no manufacturer should be called upon to replace a split drill, unless a flaw is evident in the steel.

Twist drills are made with a slight taper from the point to the shank, so that the largest diameter is always across the corners of the cutting lips. This prevents the drills from binding in the work, when they are sharp. If the outer corners are allowed to become badly worn, the drills will bind and cannot perform satisfactorily. Whenever the outer corners of the cutting lips show wear, the drills should be reground and the worn surface completely removed, or the drills will continue to bind and very quickly be damaged beyond repair.

Suggestions for facilitating the setting-up of work

Simple jigs used with a large percentage of railway shop drilling will eliminate the necessity of laying out the work previous to drilling. For example, cotter holes in small pins may be drilled by locating the center of the hole in one pin by resting this pin in the table tee slot, bringing the work to the proper position under the drill point and clamping the table in place. The remaining pieces of work may be drilled without laying out. It will also be seen that no fixture is required here beyond using the slot in the drilling machine table.

There have been many jigs and fixtures designed in railroad shops to facilitate drill press production. The application of a few of them is shown in the illustrations. The description of a few jigs and fixtures which can be used to advantage in any railway shop will be given in the following pages.

A chuck for use on the base of a radial drill when drilling locomotive cylinder castings is shown in the drawing. The device is designed for use with piston valve cylinders and the casting is swung about the axis of the valve chamber. By revolving it about this axis, any adjustment of the cylinder may be made to provide for the drilling of all holes at right angles to the axis of the bore.

The cylinder is carried on cone centers shown at *A* and *B* in the drawing, which are mounted on the head stock *C* and the tail stock *D*, respectively. The head stock and tail stock are heavy iron castings which are mounted on cast iron bases *E*, the latter serving to raise the centers the required distance above the base of the radial drill. The tail stock is fitted with a lead screw and clamp of the same type used on lathes; the handwheel *F* operates the lead screw and serves as a means of adjusting the distance between the cones when clamping the cylinders in place.

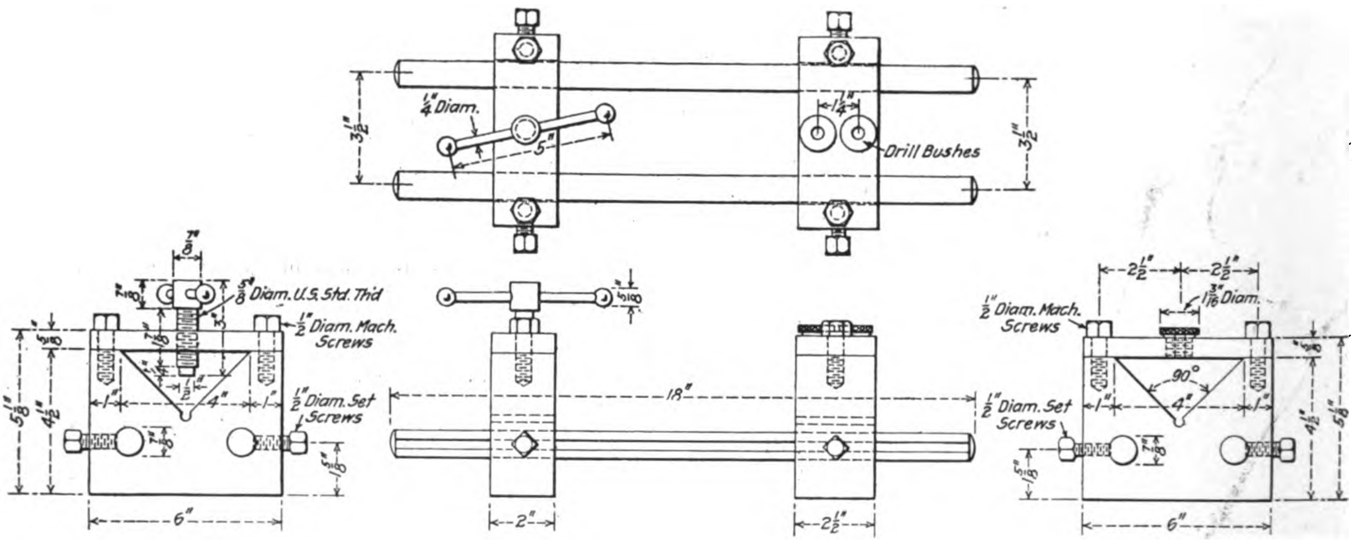
Cone *A* may be revolved about its axis in either direction by means of the handwheel *G* and a gear train. To a flange at the base of the cone is secured a driver plate which is bolted to the cylinder, causing the latter to revolve when the cone is revolved. Thus any portion of the cylinder casting may be brought into position at right angles to the drill spindle, where it is clamped by means of a ratchet and pawl device. The ratchet wheel *H* is rigidly mounted on the shaft of the operating wheel *G*. Two pawls *K*, one mounted on either side of the ratchet wheel, engage the latter and are attached to a handle *L* in such a manner than when one pawl is engaged, the other is simultaneously disengaged from the ratchet wheel. Which of the two pawls is to be used depends upon how the weight of the cylinder balances in any particular position. As the excess weight is shifted from one side of the vertical center line to the other, the position of the pawls must be changed by means of the handle *L*. The reduction gears facilitate the movement of the cylinder by hand.

By carrying the cylinder on the axis of the valve chamber bore, the weight of the casting is well balanced and comparatively small cones may be used. It is possible, however, by using large cones, to mount the casting on the axis of the cylinder and this practice is followed when slide valve cylinders are to be drilled. When used in this manner, the head and tail stocks are removed from the castings *E* and mounted directly upon the radial drill base, thus keeping the cylinder at about the same height as when swung about the center line of the valve chamber.

A handy drill jig for holding locomotive handrail columns is shown in another illustration. It is adjustable for any height of column and is arranged to drill and tap the hole in the base as well as to drill the large hole in the head for the railing pipe. As indicated in the illustration, the movable bracket is adjusted to suit the handrail column and a spanner wrench is used to tighten the hollow, threaded holding nut.

After the bushings have been pressed in side rods, it is necessary to drill holes for the grease plugs which serve two purposes: controlling the supply of grease to the bearings and preventing loose bushings from turning in the rods. The common methods of drilling these holes is to place the rod under some type of drill press and drill down through the brass bushing with a drill somewhat smaller than the smallest diameter of the grease plug threads.

There are two objections to this method in that the drill damages the threads in the rods and usually drills a hole which is off center in the rod bushing. When the attempt is made to apply a grease plug, it is often found, therefore, that the threads are damaged to such an extent that the plug cannot be turned into the rod. Moreover, the cylindrical end of the grease plug will not enter the hole in the brass bushing, and the usual procedure of the machinist is to grind down the end of the grease plug until it will fit the hole in the bushing. This results in the diameter of the plug being considerably smaller than would otherwise be necessary and should the bushing become loose in service, considerable play of the bushing in the rod may be expected.



Drilling jig for drilling holes in coupler pins

To obviate these objectionable features, the arrangement shown in one of the illustrations has been devised. It consists of a steel jig *A*, drilled for a 1 5/32-in. hole and formed at one end in a hexagonal nut. A collar is threaded to suit the internal threads in the side rod grease cup until it strikes the bottom and it guides the drill when drilling the hole in the side rod bushing. It is apparent that this jig will not only guide the drill and prevent damaging the grease cup thread, but the hole in the rod bushing will be centrally located and no difficulty will be experienced in applying the grease plug.

One of the illustrations shows a simple jig used in railway shops to drill holes in coupler pins. A cover of the simplest design contains the guide bushings, which are

changeable to suit whatever drillings are required and which can handle a variety of such work with great rapidity. The bushing holder can be raised or covered to suit different diameters of work. Both V-blocks in which the work rests are adjustable by means of the screws for different lengths of pins and lend themselves well to a variety of work of all descriptions. It also provides a clamping device which is essential to keep the work in position while being drilled. It is simple and efficient and a characteristic example of an adjustable type of jig.

Air clamps for holding work on the table are now common tools used in most railroad shops. The air clamp shown in the drawing is small, easy to handle and uses a minimum of air. It is placed on the bed of the machine instead of on the floor.

Some unusual work handled on a drilling machine

A drilling machine can be used for reaming, boring and chamfering, in addition to drilling. The possibilities of this machine have been given much thought in various railway shops, with the result that it is now handling work which in the past has been considered only possible on other types of machine tools. Some of the illustrations show several such drilling machine operations which are used in different railway shops in this country. The eleven views on the full page of illustrations will be referred to first.

When fitting tapered bolts in such parts as main rods, eccentric crank arms, etc., it is often necessary to ream the hole so that the bolt will fit. The common method of doing this work is by means of an air motor which is slow, hard work, particularly if the hole is of any size. Photograph No. 1 shows the holes in a main rod strap being reamed complete in one hour on a Cincinnati-Bickford 6-ft. radial drilling machine located in an erecting shop.

Cutting out the knuckle pin holes in a locomotive side rod can be performed to advantage on a drill press. No. 2 shows a side rod from a Consolidation locomotive set up on an American 6-ft. radial. The first operation is to drill out a 2½-in. hole, using a speed of 94 r.p.m. and a feed of .009 in. The next operation is to rough bore the hole using a 9-in. cutter at a speed of 33 r.p.m. and a feed of .007 in. This finish boring cut is made with an adjustable cutter set at 9½ in. The same speed and feed is used for this operation as for the roughing cut. The following figures show the time required for completing both ends of a side rod.

Operation	Time, min.
Setting up and changing tools	15
Drilling	25
Rough boring cut	45
Finish boring cut	45
Total time	130

The drilling machine at times is used for doing quite unusual jobs. No. 3 shows a Baker vertical drilling machine milling a 5½-in. long by 1⅛-in. wide keyway in a 4½-in. diameter piston rod. After the work is set up, an initial hole is first drilled. The reamer is then put in the spindle. The lower end of the reamer revolves a steel bushed T-block which slides along as the reamer is fed into the work. This job is completed in 21 min. using a spindle speed for the reamer of 215 r.p.m.

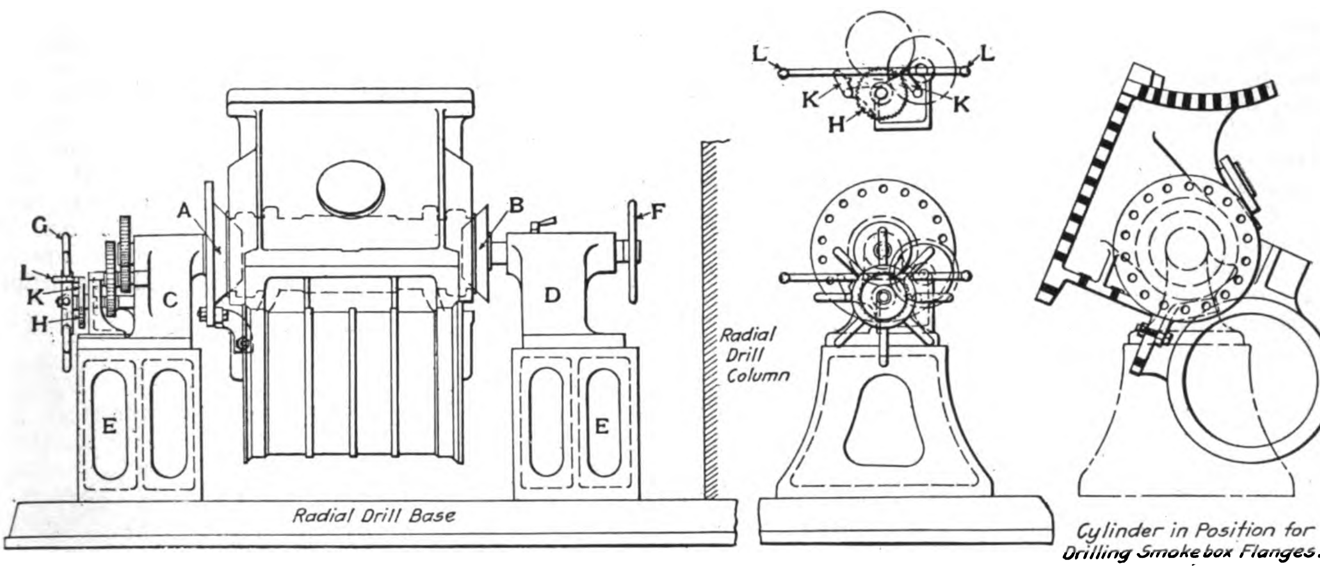
This job was formerly done on a regular piston rod keyway cutter which was equipped with two tools, one working from each side. The time required on this machine was 2 hr. and the work was not satisfactory, as a ridge where the two reamers met was left in the middle of the keyway.

Drilling machines are used in connection with driving box repairs. This is especially true in the case of boring and chamfering. No. 4 shows a Colburn 24-in. vertical drill press which was used to handle the overflow from the regular driving box boring machines. The driving box shown in the illustration was bored and chamfered in 40 min.

No. 5 shows a Baker vertical drilling machine which is used entirely for milling the straight and cross grease grooves in driving box shells. A jig is mounted on the table in which slots are cut to correspond to the grease grooves in the shell of the box. By an ingenious arrangement the end mill cutter follows the grooves in the gig with the result that the grease grooves can be cut in the shell in 20 min., floor to floor.

It is always desirable, when boring out the cylinders of an air compressor, not to have to take the compressor apart. This is not necessary when boring out a compressor on a radial drilling machine. View No. 6 shows a cross-compound air compressor mounted on the bed of an American 6-ft. radial drill press. All four-cylinders were rebored for new bushings, the roughing cuts requiring 4½ hr. to complete.

Besides drilling holes, the drilling machine can be used



Radial drill chuck with cylinder in place

for other work in connection with boiler shop repair work. The usual method of cutting a scarf on a flue sheet is with a pneumatic hammer. No. 7 shows a back flue sheet fastened by two bolts and one clamp bolt to the bed of a Baker single-spindle drilling machine. The flue sheet is scarfed in 6 hrs. using a 3-in. taper reamer at a speed of 103 r.p.m.

Multiple spindle machines are used in many railway shops, particularly where enough work is available to operate on a production basis. No. 8 shows a Moline six spindle drilling machine on the table of which is mounted a fixture for holding twelve valve motion pins at one set-up. Thus the six spindles are in continuous operation for as the holes are being drilled in both ends of six pins, six other pins are being placed in the fixture. In this manner 100 pins are drilled at both ends and finished complete in 8 hrs.

No. 9 shows a Foote-Burt three-spindle drilling machine on the table of which are mounted three different locomotive repair parts. At the left may be seen a driving box wedge having a 2⅝-in. wedge bolt hole drilled in it. The hourly production of these is 20. The middle view shows two spring rigging hangers in each end of each of which is drilled a 2⅛-in. hole. Twelve hangers are completed in one hour. The view at the right shows a 3 1/32-in. hole being drilled in a spring rigging bushing, ten of which are completed in an hour. It will be noticed that all the work is held by an air-operated clamp.

No. 10 shows a Niles-Bement-Pond four-spindle drilling machine drilling four holes in an arch bar, requiring only 10 min. from floor to floor.

Another interesting job of multiple spindle drilling machine work is shown in No. 11. Here may be seen a Foote-Burt six-spindle drilling machine drilling nine 1¼-in. holes in a switch frog point in 20 min.

Locomotive side rod knuckle pins can be drilled and turned on a drilling machine provided the proper tools and fixtures are available. One of the accompanying illustrations, consisting of three views, shows a Colburn single-spindle drilling machine which is used to drill and form knuckle pins. The forgings are held in place in the fixture by five set screws. The first operation, which is shown in the middle view, is to drill the hole for the collar plate bolt to pass through. Then the drill is removed from the spindle and replaced with the forming tool shown in the illustration. The work the forming tool does is shown in the view at the right of the group. This method is much quicker than turning the knuckle pins in a turret lathe.

The drilling and tapping of the holes in a new locomotive cylinder is a job which should be handled on a radial drilling machine. By the proper application of jigs this work can be greatly speeded up. The illustration, containing four views, shows a new cylinder being drilled, tapped and reamed by a Carlton 6-ft. radial drilling machine. A total of 180 holes are drilled and tapped and all necessary reaming completed in 12 hrs. The left and top center views show the steam pipe flange and saddle gages, respectively, in place.

The use of these jigs eliminates a considerable amount of the laying off work usually required. The view at the right shows the reaming of the steam pipe flange collar fit in five minutes. When the cylinder reaches the erecting shop no further drilling, tapping or reamer is required.

One of the views shows a Baker double-head drilling machine which is used only for boring out the brasses in locomotive driving rods. From eight to ten sets of side rod bushings are completed in eight hours.

If the proper fixture is provided, engine truck brasses, after being babbitted, can be readily bored to size on a drilling machine. The illustration, consisting of two views, shows a Foote-Burt single-spindle drilling machine on the table of which is mounted a fixture for holding engine truck, trailer and driving box brasses when boring to fit. The brass shown is a 5½-in. by 9-in. engine truck brass. The brass was completed in eight minutes from floor to floor. The depth of cut at the outside edge was ⅜ in. and at the middle 7/16 in., the cutting speed being 190 r.p.m.

Conclusion

The variety of work that can be performed on a drilling machine makes it an important tool to have in a large or small repair shop or engine terminal. A modern radial or vertical drilling machine can be used in the smaller shop not only to handle the ordinary drilling work, but to take care of boring, reaming, milling or chamfering repair work which is ordinarily handled on special duty machines. In the larger shop where greater quantities of work is handled, special duty machines are more economical, but a modern drilling machine can be used in an emergency to handle such jobs as boring driving boxes, truck brasses, reaming, etc., when the regular machine either is out of service for repairs or is unable to handle an unusual quantity of work. Furthermore, this type of machine can be economically used at times and under certain conditions as a production machine, as, for instance, in the making of knuckle pins.

In summing up the important points to be considered in the successful operation of the drilling machine, first, the machine must be considered on a par in importance with the turret lathe, milling machine, shaper, etc.; second, the operator must be properly trained to secure the maximum efficiency from the machine; third, the work should be carefully studied in order to design jigs and fixtures to increase production; fourth, all work coming into the shop should be carefully studied to determine whether or not it can be more economically machined on a drilling machine.

Educational bulletin of the American Railway Association

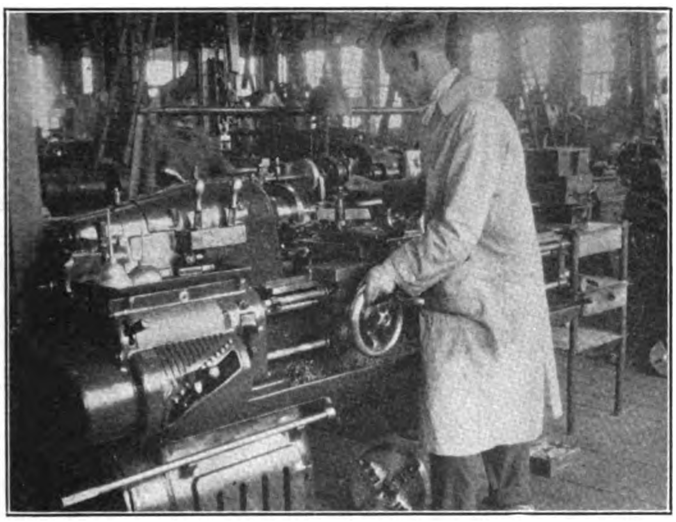
General view of system tool room at Milwaukee locomotive shops

System tool room on C. M. & St. P.

A description of how the Milwaukee has standardized tool equipment and centralized tool facilities at one shop

By O. D. Kinsey,
Tool supervisor, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

ABOUT two years ago the Chicago, Milwaukee & St. Paul started to standardize and catalog its tool equipment and lay plans for a system tool manufacturing department at Milwaukee shops in order to provide better tools and necessary labor-saving devices to reduce shop labor costs and extend the service life of the many costly appliances used on locomotives and cars.



Operator working at modern tool room lathe

Good tools are just as essential in a railroad shop as in an industrial plant and they have the same direct relation to the amount, quality and cost of work done. Many expensive appliances, such as are today used on locomotives and cars, find their way to the scrap pile long before they should on account of a failure to provide good tools for proper maintenance. We believe in giving workmen proper tools, well-designed and maintained in an efficient manner. Then the sledge hammer method can be eliminated to a great extent, saving both material and labor.

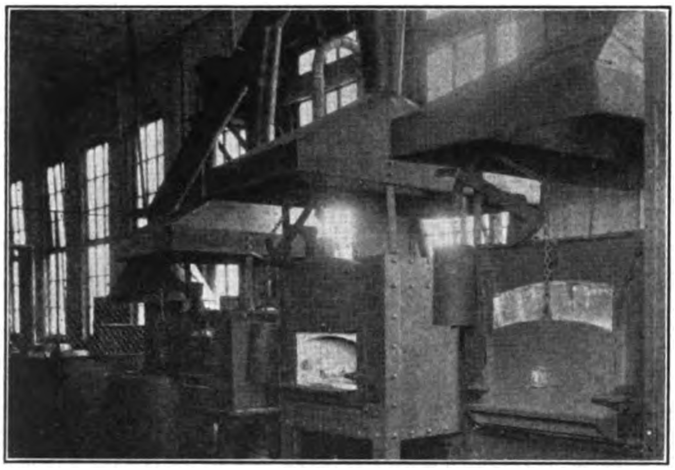
Locomotives and cars are practically standard, and similar equipment is required at each shop point, as the same maintenance problems have to be met. Therefore, to secure uniform shop practice on a railroad system it is important that the equipment be standardized and the manufacture centralized and controlled by means of a book of tool standards covering both commercial tools and equipment, as well as special tools and devices.

Standard tool folios have been made up and distributed to all supervisors and storekeepers on the C. M. & St. P. lines. This folio lists the best equipment available as gathered from our own shops and the practice on other railroads and is subject to revision as better ideas are suggested or better tools are developed.

When each shop as a railroad system has to depend on its own resources for making up small tool equipment, without having proper material, milling, grinding and heat treating facilities, as many ideas and designs will be found as there are men involved, with tool costs unreasonably high and tool efficiency low.

The Chicago, Milwaukee & St. Paul has centralized tool work at its main shops at Milwaukee, Wis., where necessary materials and machinery are now available to turn out high grade equipment at a minimum cost. Take for instance any standard special tool such as a valve seat-

ing reamer for air pumps. These reamers are now produced on a store order for stock, ready for quick delivery when called for; and advantage is taken of ma-



An effective exhaust system carries off smoke and hot gases from the furnaces

chine set-up and efficient production equipment which not only gives a better and standard tool but reduce costs.

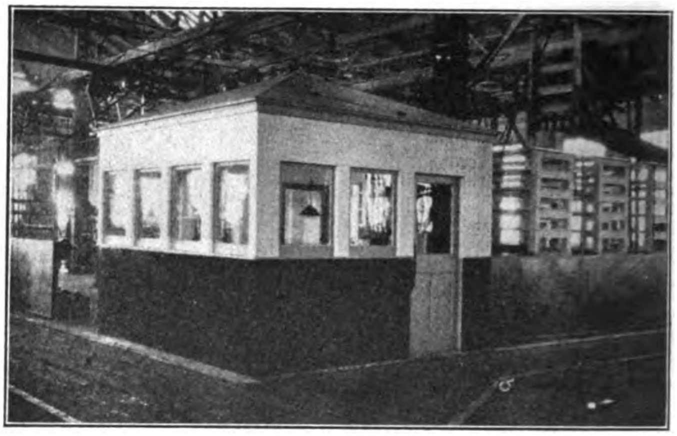
Standard commercial tools purchased

We do not contemplate the manufacture of standard commercial tools such as standard taps, drills, reamers, etc., but only special maintenance tools and labor-saving equipment. All standards for tools purchased on the open market, or manufactured in the central tool department, are controlled by the tool supervisor and a tool committee.

The central tool department has an experienced tool designer whose duty it is to study ways and means for reducing shop costs, through the development of good equipment which, when finally approved, is entered in the tool folio as standard until something better is developed.

The real value of a tool is not so much dependent upon the initial cost as upon what it will produce in work and the resultant saving in dollars and cents.

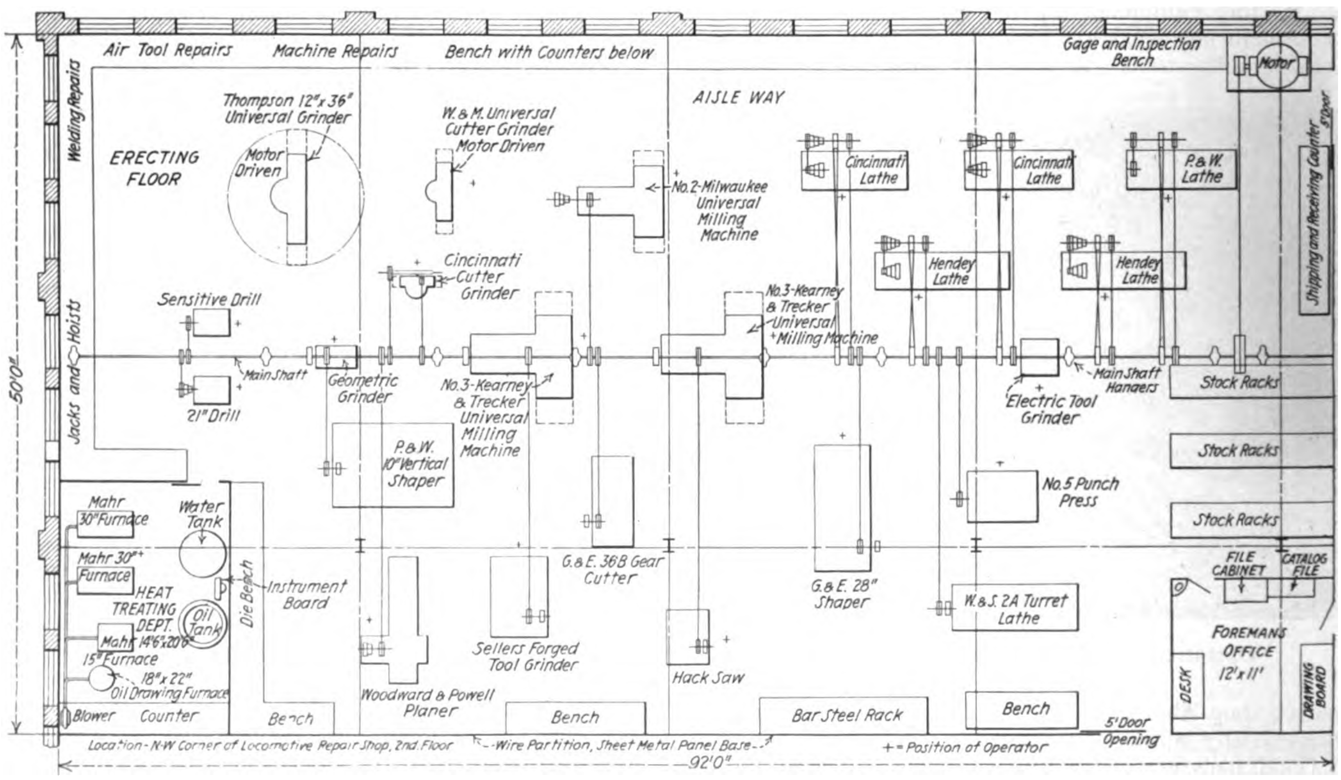
A cheap tool made of poor material, incorrectly designed or heat treated, becomes a very expensive tool when assigned to the present day workman. For instance, a common hand chisel if purchased on a price basis alone, without regard for the kind of material used or the care with which it is forged and heat treated, may cost the user several times the price of a good tool through time lost in the shop. So it is with commercial tools in gen-



Tool room office with tool racks showing at the right inside the enclosure

eral, such as taps, dies, reamers, etc., which may have a good appearance and be finely polished, but lack the essential elements of quality.

The Chicago, Milwaukee & St. Paul appreciates this fact and now purchases on specification to insure quality and efficient performance in the shop. For example, the various sizes of boiler taps have been standardized at ¾ in. taper per foot and 12 U. S. S. form thread, with

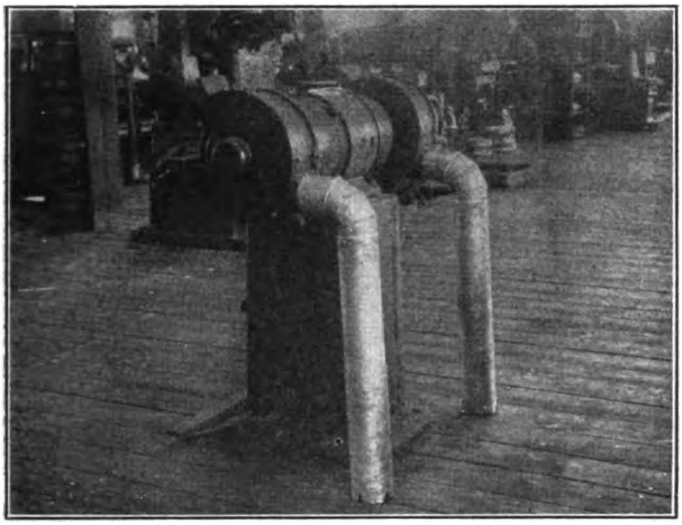


Arrangement of tools and facilities in the C., M. & St. P. tool room

standard squares and flutes and a specified face cutting angle. These taps increase in ⅛-in. steps, yet any 1/16-in. size hole may be obtained.

New and repair work for the system handled

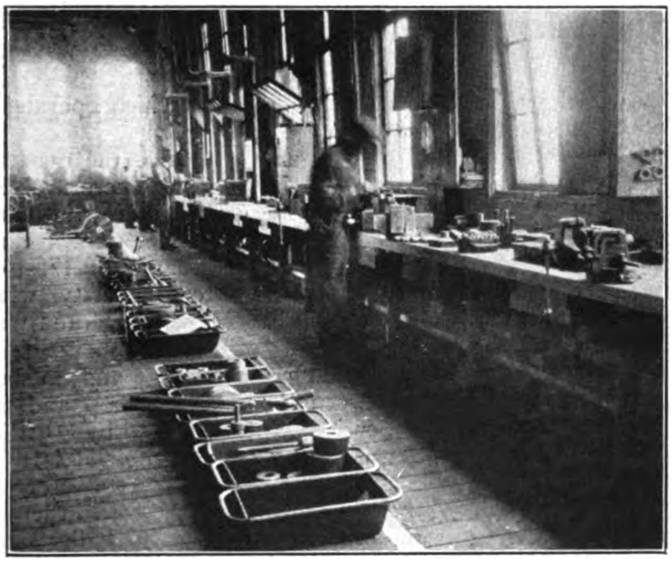
The central tool department is for the benefit of the rail-



Grinder exhaust pipes tend to keep abrasives out of the air

road system as a whole and both new and repair work is handled on store orders, charged out at cost and distributed through the stores department.

The old saying, "Too many cooks spoil the broth" is literally true when applied to tool making. With our new facilities we can produce real tools in quanties at a fractional cost of that which obtained when these tools were



Standard work moves in "tote pans" from operation to operation

made in small quantities at outlying points with more or less inadequate tool equipment.

The best and most modern equipment obtainable has been installed in the tool department which occupies a 50-ft. by 92-ft. space in the northwest corner of the Milwaukee locomotive shop. A wire partition divides the tool room from the rest of the shop and the tool room office in one corner of the enclosure is provided with a suitable desk, correspondence of catalog file and a draftsman's board at which tool designs can be developed.

The machinery is grouped in classified order, preference being given to the location of precision machines where the light is best. The heat treating department is located against the west wall, being in a separate wire enclosure to prevent interference with heat treating operations. Bench work is confined to the west end of the tool room, the north wall counter being used for material in process.

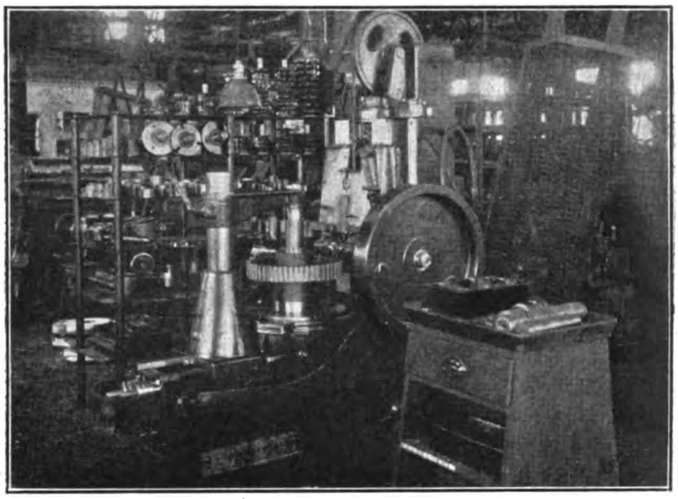
A routing system for all standard operations has been arranged, which moves the work in tote pans from operation to operation until it is finally inspected and placed in the stores stock.

A typical example of this method is as follows: A store order is issued for possibly three dozen standard gage cock reamers—Catalog No. T 1-1.

The tool foreman assigns this order by work slip to the screw machine operator who has a mounted blue print showing detailed construction and the operations to be performed by him as follows:

Operation 1, *Screw Machine*—Turn to blue print and allow 0.010 in. for grinding and cut off.

This operation starts the job moving. A bar of tool



A modern gear cutting machine is part of the tool room equipment

steel, placed in one end of the machine spindle, is quickly reduced to part No. T 1-1 and cut off on the other by duplicating movements. When three dozen pieces are run, the operator turns in a material ticket with his assignment slip, places the semi-finished job in a tote pan which is then ready for assignment to subsequent operations.

Operation 2, *Milling Machine*—Mill flutes and square shank.

Operation 3, *Bench*—Burr and stamp tool number.

Operation 4, *Heat Treating Department*—Harden and draw.

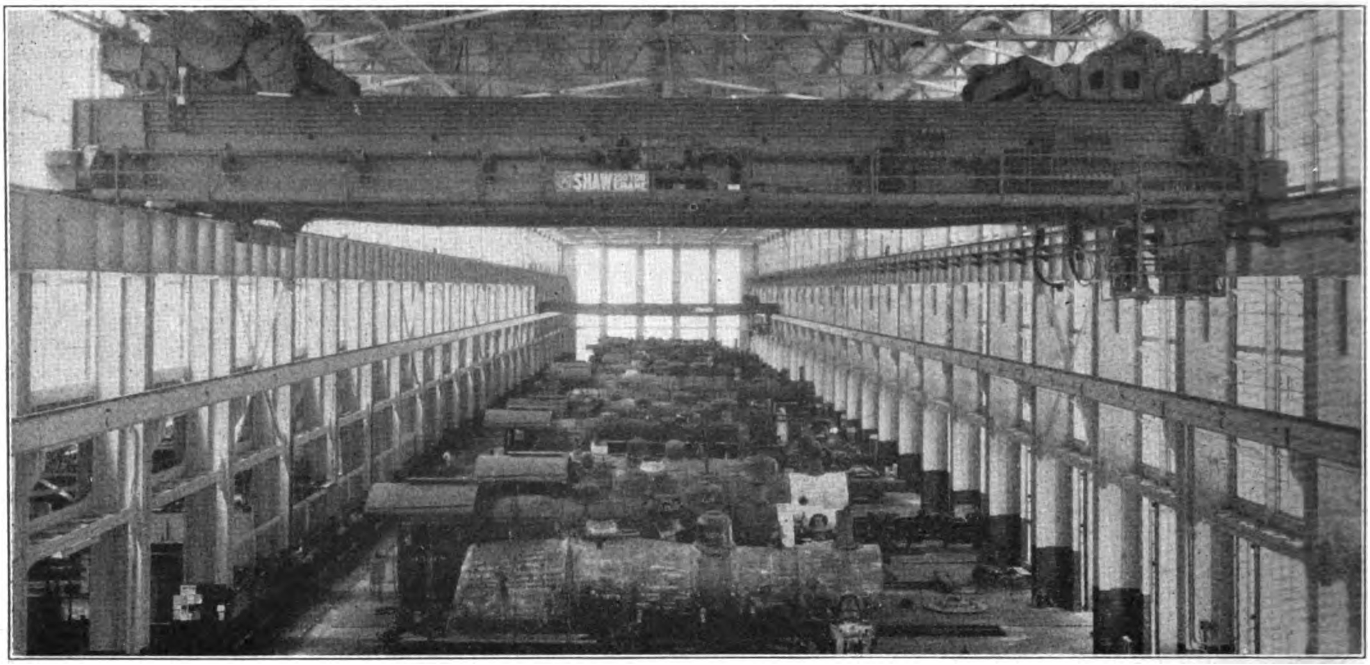
Operation 5, *Grinding Department*—Grind and finish to print.

Operation 6, *Inspection Bench*—Inspect and O. K. to stores stock.

The shop layout drawing shows the kind of machinery installed. It will be noted that it is all modern equipment and we endeavored to balance the turning, milling, heat treating and grinding equipment to provide capacity for a steady flow of work in process. We believe we have worked out an efficient arrangement in this regard.

Practically all work in process, also raw materials, are carried in stores account, excepting direct repair work required by the local shops which is charged to Account 302.

All requisitions covering both purchased and manufactured tools are checked, corrected and approved by the tool supervisor before going to the purchasing agent.



Machine shop erecting bay served by 250-ton crane

A. T. & S. F. San Bernardino locomotive shops

Stripping pits and 21 pits for heavy boiler and tender work in boiler shop—30 pits in erecting shop

THE San Bernardino, Cal., locomotive shops of the Atchison, Topeka & Santa Fe constitute one of the largest locomotive repair plants in the country and, together with the car department, occupy a site of about 66 acres opposite the San Bernardino passenger station. The buildings are mostly new; however, some parts of the old buildings were utilized by additions or by removing and rebuilding. In general the new repair facilities comprise a machine shop, boiler shop, blacksmith shop, pipe, tin and welding shop, and flue shop. All these buildings are of steel framing with walls of brick or concrete. Liberal use is made of steel sash both for light and ventilation. The floors of the machine shop and boiler shop are all of wood blocks laid on concrete, and the roofs are of laminated wood construction covered with fireproof roofing so that the entire shops are fireproof and also well lighted and ventilated.

The machine shop and boiler shop each face a transfer table 65 ft. in length which handles locomotives and material between the two shops. There are 30 pits in the machine shop and 29 pits in the boiler shop. The machine shop is 673 ft. in length and 201 ft. in width and is comprised of three bays—an erecting bay 90 ft. in width, a light machine bay of 46 ft., and a heavy machine bay 65 ft. in width. Over the erecting bay operates a 250-ton electric traveling crane with 15-ton high speed hoists, while on a runway below this crane are two 15-ton cranes. Over the heavy machine bay are two 15-ton cranes supplemented by another 15-ton crane over the wheel storage outside of the building which is at right angles to the machine bay. Outside of the machine shop building is a material platform 43 ft. in width over which operates a crane also of 15-ton capacity.

The boiler shop is of the same length as the machine shop (673 ft.), and is 164 ft. in width. There are two bays in the boiler shop, an erecting bay 90 ft. in width and the machine bay 74 ft. in width. The electric traveling crane which operates over the erecting bay is of 175-tons capacity with auxiliary hooks of 15-tons capacity, while over a portion of the machine bay operates a crane with a capacity of 15-tons.

The blacksmith shop building and the pipe and tin shop building are located between the machine shop and the roundhouse. The former is 306 ft. in length by 80 ft. in width, while the latter is 213 ft. in length by 67 ft. in width.

The flue shop is in a separate building 108 ft. in length by 45 ft. in width and situated outside of the boiler shop.

Other new buildings included in this improvement consist of the power house 103 ft. long by 81 ft. wide, also of steel framing with concrete walls, and a sheet metal storage building 193 ft. by 101 ft., paint and grease shop, office, apprentice school building, fire hall, and assembly hall, together with lavatory facilities.

The store department building is being enlarged by an addition of three stories 275 feet in length, and also an extension of 500 ft. is being made to the material platform which will make the storehouse building altogether 50 ft. in width and 600 ft. in length, and the material platforms of the same width by 1,450 ft. in length.

Locomotives are handled into the repair shops on the transfer table 120 ft. in length which operates back of

the boiler shop. This length of table is employed so that it will accommodate the largest locomotives with tender as well as the shop shifting engine. The locomotive is set on the stripping pits, Nos. 24, 25 and 27 of the boiler shop, while the tender is shifted to one of the storage tracks back of the boiler and tender shop.

Since all engines in the territory served by this shop burn fuel oil the work on oil tanks and tenders is an important factor. On these tender storage tracks facilities

Transfer table between the machine and boiler shops with a heavy Mountain type locomotive on the table

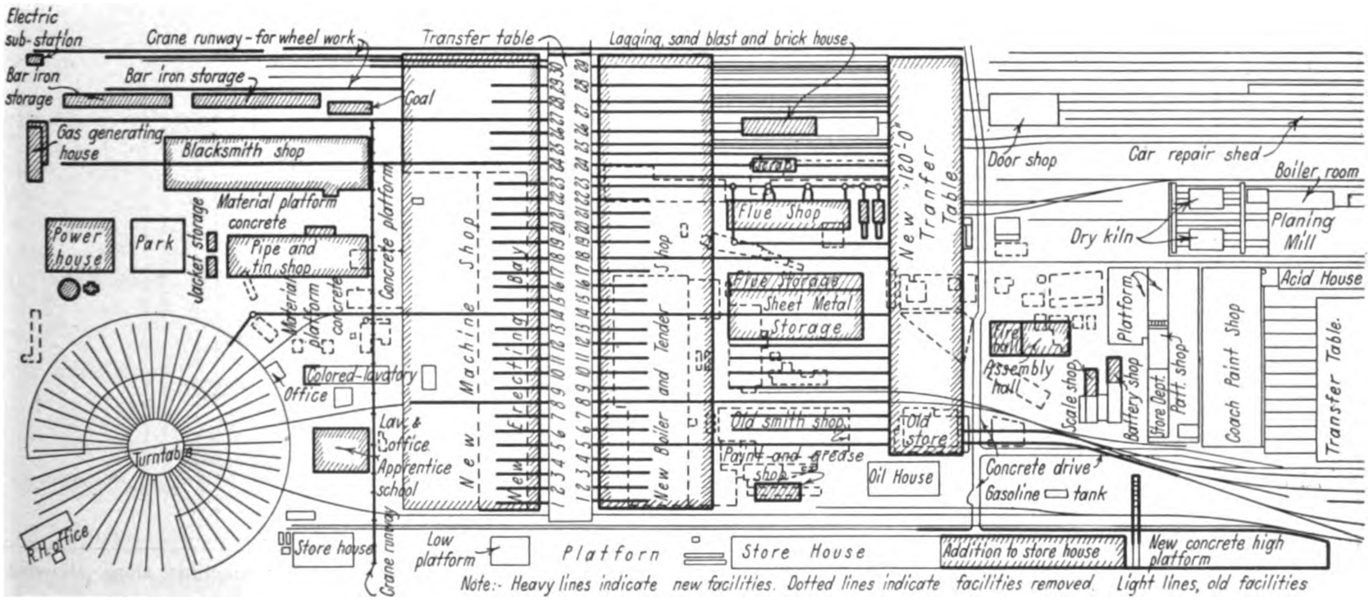
are provided for draining the oil from the tender oil tanks and running it into a storage where it is pumped to fill the oil tanks of engines going out of the shops. These facilities also steam out the oil tanks and prepare them for the shop. The oil carried out by the steaming process is reclaimed by means of a separator and conveyed to the fuel oil storage.

A rather novel arrangement is employed at the stripping pits, in that the lye vats are located inside of the building so that the traveling cranes which remove parts from locomotives can afterwards place these parts directly into the lye vats. There are four lye vats each 20 ft. by 10 ft. by 4 ft. 6 in. deep. In addition to the traveling crane each vat is also supplied with a jib crane with a geared air hoist of 2-ton capacity. When the parts have been cleaned they are delivered across the transfer table by storage battery or gasoline driven shop trucks to the machine shop or material platform outside of the machine shop. If boiler repairs are required the 175-ton crane conveys the engine directly to a pit in the boiler shop.

Machine work

The wheel and driving box work is done at the north end of the machine shop. This work is very heavy as the locomotives served by this shop operate on mountainous and considerable desert territory, and as a result the tires require turning frequently and the sand and grit collecting in the bearings necessitate a great deal of driving box and journal work. It is customary to send locomotives into this shop from a number of points on the Coast Lines for this class of work as it has been found much more convenient and economical to handle the engines with the cranes and equipment in this shop than with the drop pits in the roundhouse.

For the driving wheel work itself the shop is equipped with two 90-in. driving wheel lathes, one journal truing lathe, a 52-in. car wheel turning lathe for trailer and truck wheels, and in addition, two quartering machines together with boring mills, axle lathes, etc., as shown in the detailed list included in this article. These machines are served by the crane in the heavy machine bay as well as by jib cranes with geared air hoists. Outside of the machine shop and adjacent to the driving wheel gang is an ample wheel storage. This storage is at right angles to the main shop and is 40 ft. wide and 440 ft. long, and is under the 15-ton electric traveling crane. Here are not only the wheels for engines in the shop, but also storage of new tires, wheel centers, etc. At the end of the storage space nearest the shop, room is made for tire dismounting and mounting work, and counterbalancing of wheels. This work is protected by a canopy. The tires for mounting are heated in an 8-ft. by 16-ft. car bottom furnace, the temperature being controlled by a pyrometer. This furnace is large enough to contain at one time a whole set of tires, and is also available for annealing locomotive parts. The work on locomotive trucks is done near the driving wheel gang using the same machinery. The trucks are assembled over a pit in the machine bay.



Plan of the new Santa Fe Coast Lines shops at San Bernardino, Cal.

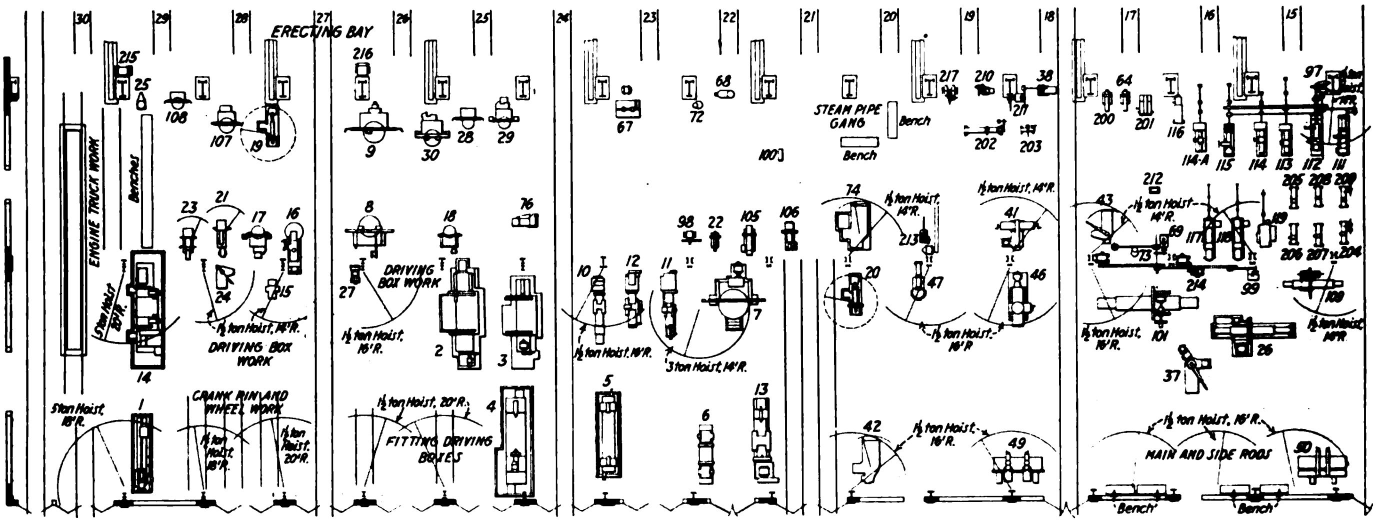
The driving box gang is adjacent to the wheel gang and

on account of the large amount of work required, this gang is amply supplied with machine tools, including a 100-ton press of the latest type, three boring mills, one of them especially fitted for boring driving boxes, and four draw cut shapers, together with the other machinery. The facing of shoe and wedge faces of driving boxes and finishing for the brass fit as well as the fit of the brass shell into the box is all done on the draw cut shapers.

out. These transfer the rods on the "horse" and also to the drill presses.

The valve and valve motion work is handled near the south end of the shop and the machines in this gang include two horizontal boring and drilling machines, two milling machines, a 6-ft. radial drill, two slotters, a small draw cut shaper, and a link grinder of the modern type.

Not all of the machine tools serving each gang are



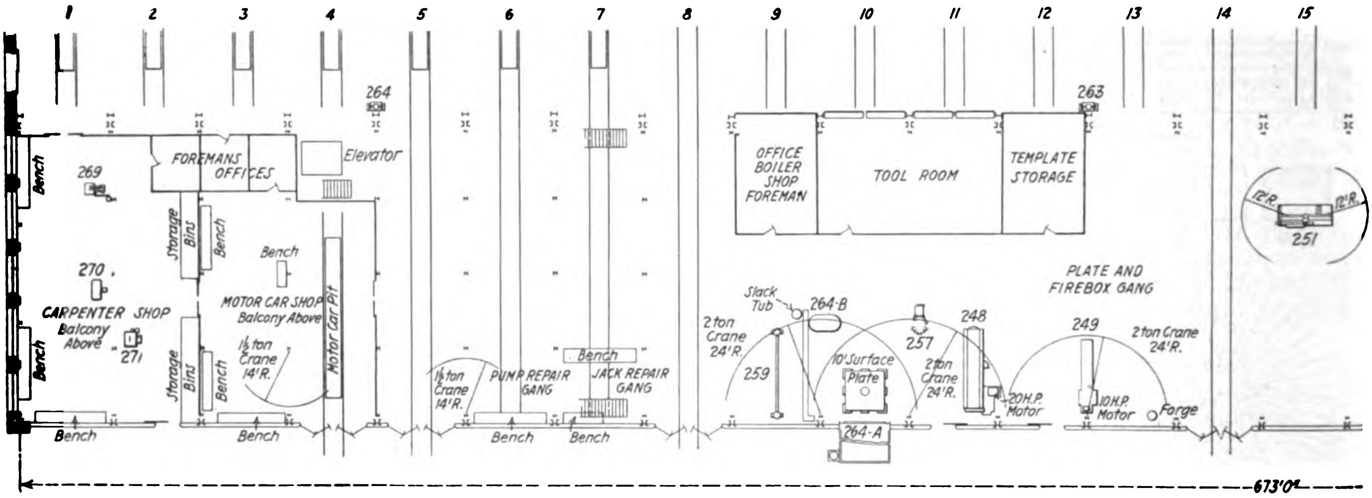
Arrangement of the machine bays

These shapers also do some work on brasses for the rod gang.

The guide and piston gang is located in the heavy machine bay, and machine equipment for this gang includes a piston rod grinding machine, and a guide grinder of the modern types, as well as other machine tools as shown in the attached list.

The main and side rod gang are also in the heavy machine bay with the machines most needed near at hand, including a large two-spindle drill press, two heavy duty

placed within the gang, as there is a large group of miscellaneous machines, especially planers, lathes and drill presses, which are near these gangs and available for all of them. These machines are located mostly in the light machine bay, but there are also a number of lathes and other machines located in the heavy machine bay. Practically all of the machinery in the heavy machine bay is individual motor driven and of modern heavy duty types. There are a few of the old belt driven lathes which are run with motors and countershafts carried on brackets



Layout of the boiler machine shop, showing

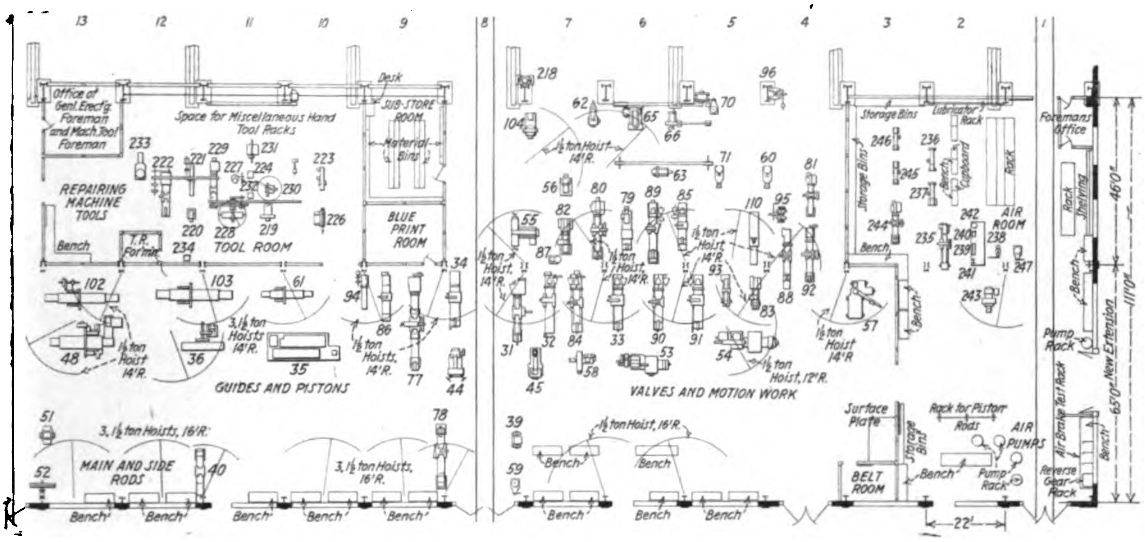
upright drill presses, two slotters, two radial drills, and three milling machines. The rods are put on "horses" and at right angles to the axis of the shop, placing the end of the rod to be worked nearest the bench and the bench against the wall, which arrangement gives excellent lighting for the work. Seven jib cranes with 16-ft. booms and 1½-ton geared air hoists pivoted on the steel supporting the building against the wall serve the rod gang through-

suspended from the building steel and carried out into the heavy machine bay for a distance of about 6 ft.

The brass, bolt, and stud work is done on a group of turret and screw machines and engine lathes, and located in the light machine bay. Most of the fitted bolts are turned by the lathes in this group, however, and there is a portable 14-in. by 6 ft. engine lathe which is used for fitting bolts on the erecting floor. The erecting floor is

also provided with six portable electric welding machines, and four double grinders conveniently placed.

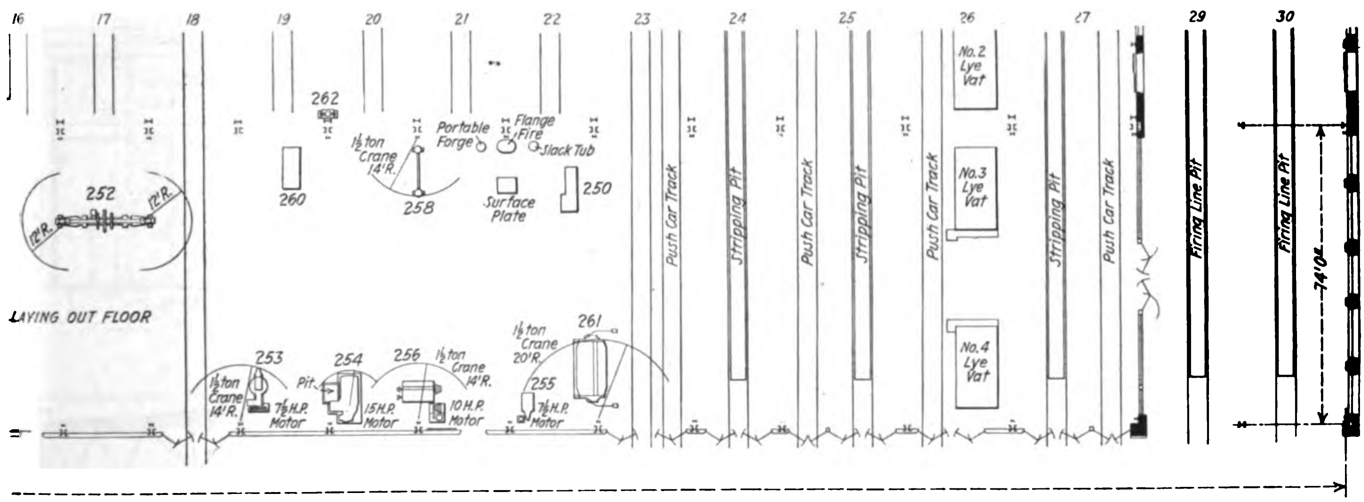
The pits in the erecting floor are all piped and have connections for water, steam, air, acetylene and oxygen gas. Electric drop cord receptacles are also provided, so that the trucking aisles on the floor are reasonably free from hose and electric cords. The pipe mains are all carried overhead with drops carried down the columns and under



at the San Bernardino shops

the floor through a shallow trench into the pits, thus making all the piping easily inspected and maintained.

The tool room is located in the center of the shop where the tool foreman can give his attention to the machine work as well as to the distribution of hand tools. The racks for hand tools issued to workmen are convenient both to the erecting floor and the machine shop. Machine tools shipped in from Coast Line shops are repaired in the tool room and these are handled by the traveling crane in the heavy machine bay to a position in front of the tool



parts of the stripping and firing-up tracks

room. No extensive manufacturing is undertaken in this tool room and the machinery is mainly for repairs to machine tools and certain parts of railway equipment usually handled in the tool room.

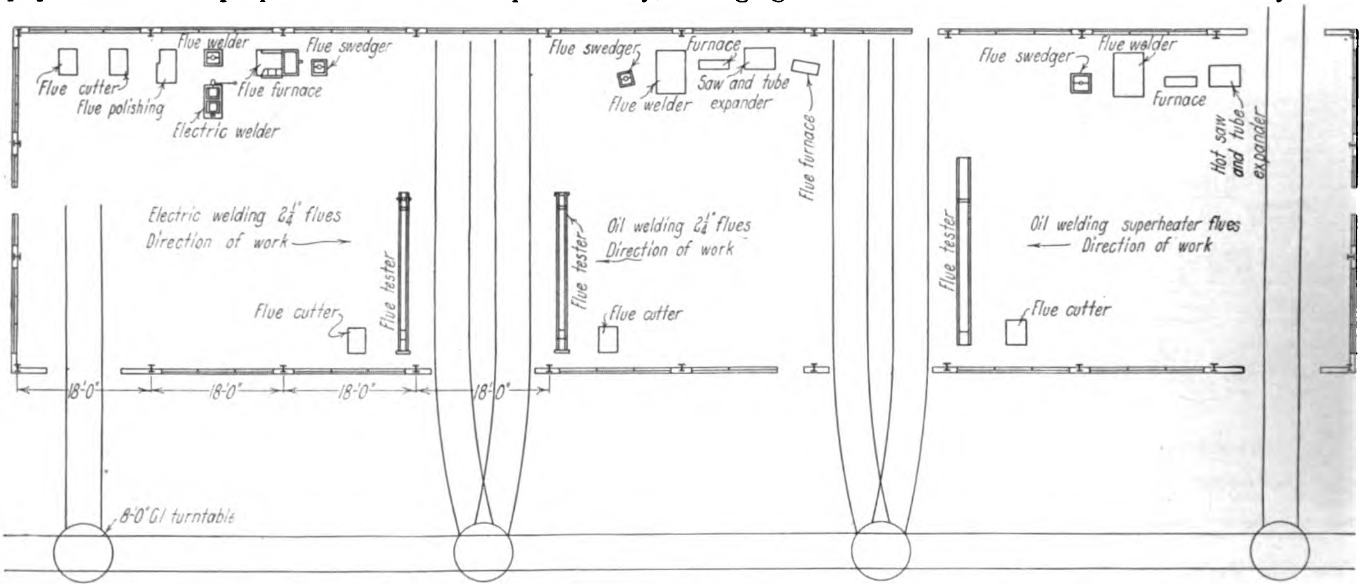
The air room is located in the extreme south end of the machine shop and extends from the light machine bay through into the heavy machine bay so that the pumps and reversing gear cylinders and mechanisms (which are also repaired in the air room), can be handled by the traveling crane. The air room is provided with all machine tools necessary to carry on the work. Also, the air room has its own lye vat on the material platform outside so that all the work of air equipment is under the supervision of the air room foreman. As is customary the tool room and air room are enclosed by metal and wire partitions.

In the center of the machine shop is located an office for the erecting foreman and general machine foreman. Adjacent to the tool room is a substore room for small supplies, and also a blue print room. All blue prints are mounted on card board and varnished, and are kept in racks in this room under the care of an attendant who sees that the prints are properly indexed and kept up to date.

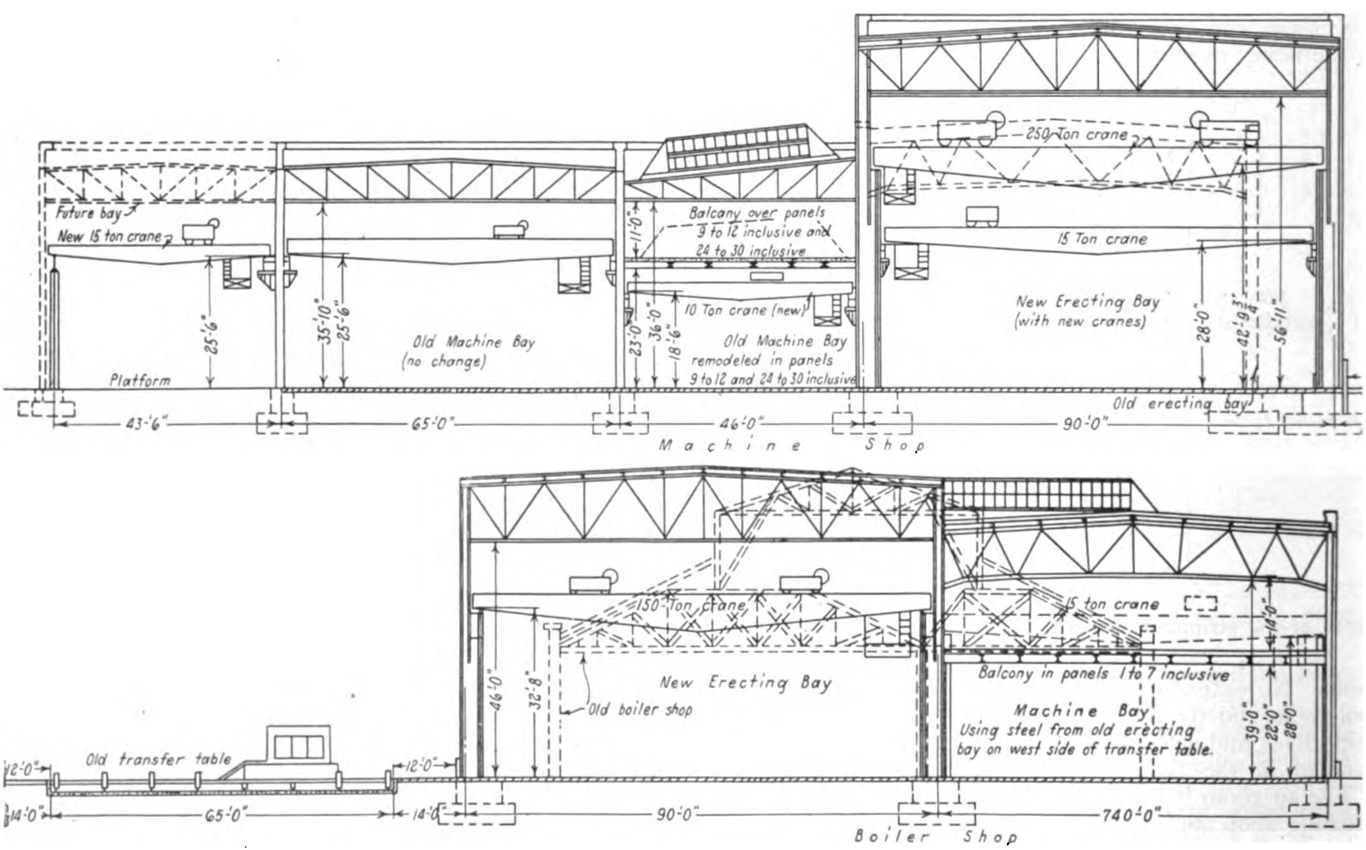
Boiler shop and tender shop

As before stated, the boiler shop resembles the machine shop in general appearance and is of the same length, but has only one machine bay in addition to the erecting bay. This machine bay is 74 ft. wide and most of the steel comprising it was taken from the erecting bay of the old machine shop. It is served by an electric traveling crane of 15-tons capacity. The erecting bay is 90 ft. wide and is served by a crane of 175-tons capacity with 15-ton high speed auxiliary hooks. The stripping pits are in one end of this building as previously mentioned.

The boiler shop is equipped for handling all the boiler work, and especially flue work, the latter being particularly heavy on account of the bad water district through which the Coast Lines engines operate. The shop, however, does not attempt to build complete back ends with fire boxes as these are usually made on shop order in the Topeka shop, which has hydraulic bull riveters and other equipment for this purpose. The boiler shop machinery, however, comprises three bending rolls, a 40-in. double end punch and shear with shearing blades for flat and round bars as well as angles and other steel shapes used in locomotive tenders. There are also two flanging clamps, an angle bending roll, a cornice brake with capacity up to 3/8 in. two pneumatic flanging clamps, a pneumatic cold flanging machine, drill presses, and other machinery as shown by the list. The work on locomotive boilers is performed on an erecting floor from panels Nos. 9 to 22, inclusive, while the work on tenders and oil tanks is handled on the erecting floor on panels Nos. 1 to 7, inclusive. The tenders are handled into the shop on track No. 8 from the tender storage outside the shop. The flanging is done near the center of the machine bay where the clamps and surface plate are placed on a concrete block 31 ft. in width by 63 ft. in length. The plate furnace measuring 10 ft. by 14 ft. is outside of the building and so arranged that the plates are taken out of the furnace into the building through the wall, in this manner keeping the heat from the furnace outside of the building. Elec-



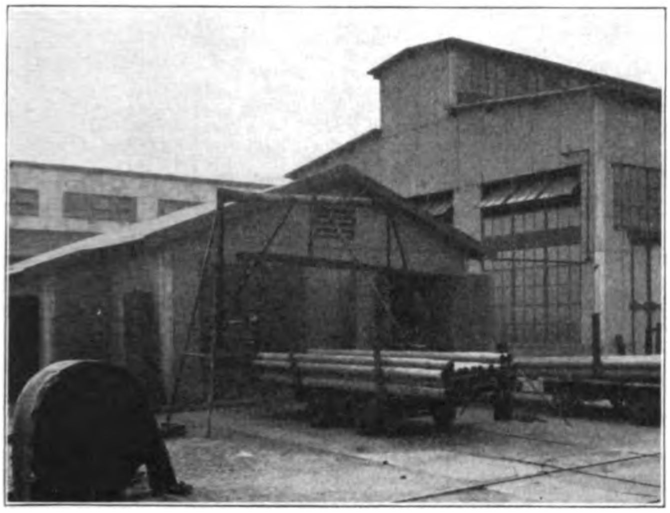
Layout of machinery and tracks in new flue shop, constructed in three units



Cross section through new locomotive shop facilities of the Atchison, Topeka & Santa Fe, located at San Bernardino, Cal.

tric pyrometers are provided to regulate the heat in this furnace.

All the machinery in the machine bay is individual motor driven. In the center of the machine bay is the office of the foremen, also tool room for workmen's hand tools, and in addition a room is provided for boiler template storage. In the extreme south end of the machine bay is



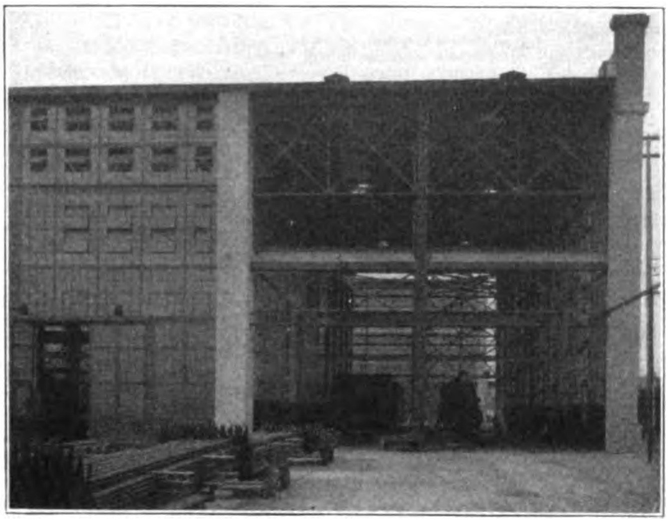
Flue rattler building and end of the flue shop building

located a carpenter shop equipped with a single surfacer, band saw, combination rip and cut-off saw with mortiser attachment for wood working in connection with the locomotives and tenders and also the motor car shop which adjoins it. The motor car shop handles repairs to motor driven hand cars and similar motor driven equipment. Adjacent to the motor car shop are three tracks in the machine bay set aside for repairs to tender trucks, which are run into the machine bay from the erecting bay.

There is a balcony over the carpenter shop, motor car shop, and truck shop extended 7 panels from the south partition of glass sash and the side walls are omitted. Monitors are provided which allow free circulation of air. The 15-ton crane operating over the machine bay runs out of the end of the boiler shop building and serves the firing up pits. A swinging door is provided in the boiler shop end wall for this purpose.

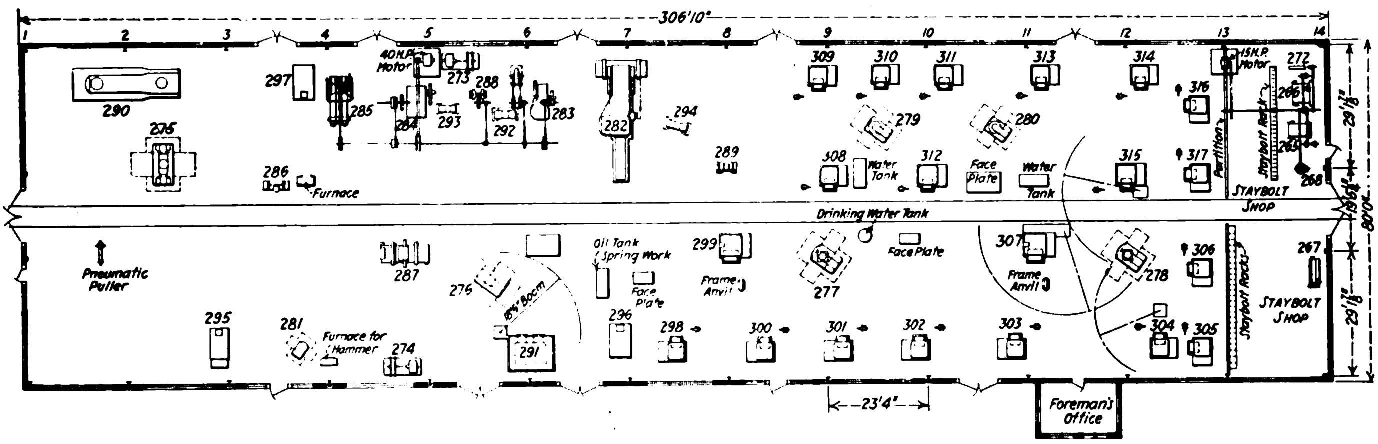
Flue shop

The flue work is done in a separate building outside of the main boiler shop, the flues being handled by push cars to the rattlers, of which there are two, both of the Baird dry type. These rattlers are enclosed in a building



Firing-up pits at the north end of the boiler shop

with sound insulated walls to lessen the noise. There are three sets of flue machinery, two for 2¼-in. tubes, of which one set is arranged for electric welding and the other for oil fired furnace welding. The third set of machines is for superheater flues and has oil fired furnaces.



The blacksmith shop layout

end, and in this balcony are lavatories for the boiler shop men, also a shop for repairs to motors and other electrical equipment, including headlight generators. The material is handled to the balcony by means of an elevator.

After the engines have been wheeled in the machine shop they are brought to two pits at the north end of the boiler shop known as the firing-up pits. Here the engines are connected to their tenders and fired up. These pits are separated from the main part of the boiler shop by a

The safe ends are cut by an automatic safe end cutting machine. The flue testers and cutters are the railroad company's make, as are also the flue rollers and flue grinders in connection with the electric welding outfit.

Steel plate storage

Boiler plates and flues are stored under cover in a building adjacent to the boiler shop. In this building the boiler plates are set on edge between rail supports and

are handled by an electric traveling crane of 7½-tons capacity having a span of 74 ft.

Blacksmith shop

The blacksmith shop has equipment both for heavy and light forging work. This shop handles not only the locomotive department, but the car department, as well as some shop order work for points on the line. In the way of steam hammers it has one 4,000-lb. double frame ham-

Tools and facilities in the San Bernardino Locomotive Shops

(Reference numbers refer to drawings)

WHEEL REPAIR GANG

Tool reference number

1—1 600-ton wheel press
2 and 3—2 90-in. driving wheel lathes
4—1 journal truing lathe
5 and 6—2 quartering machines
7—1 96-in. boring mill
8—1 84-in. boring mill
9—1 72-in. boring mill
10—1 36-in. x 18-ft axle lathe
11—1 48-in. x 16-ft. engine lathe
12—1 36-in. x 12-ft. engine lathe
13—1 54-in. x 14-ft. engine lathe
14—1 52-in. car wheel turning lathe
18-ft. x 16-ft. car bottom tire heating and annealing furnace
1 counterbalance rock

DRIVING BOX GANG—MACHINERY

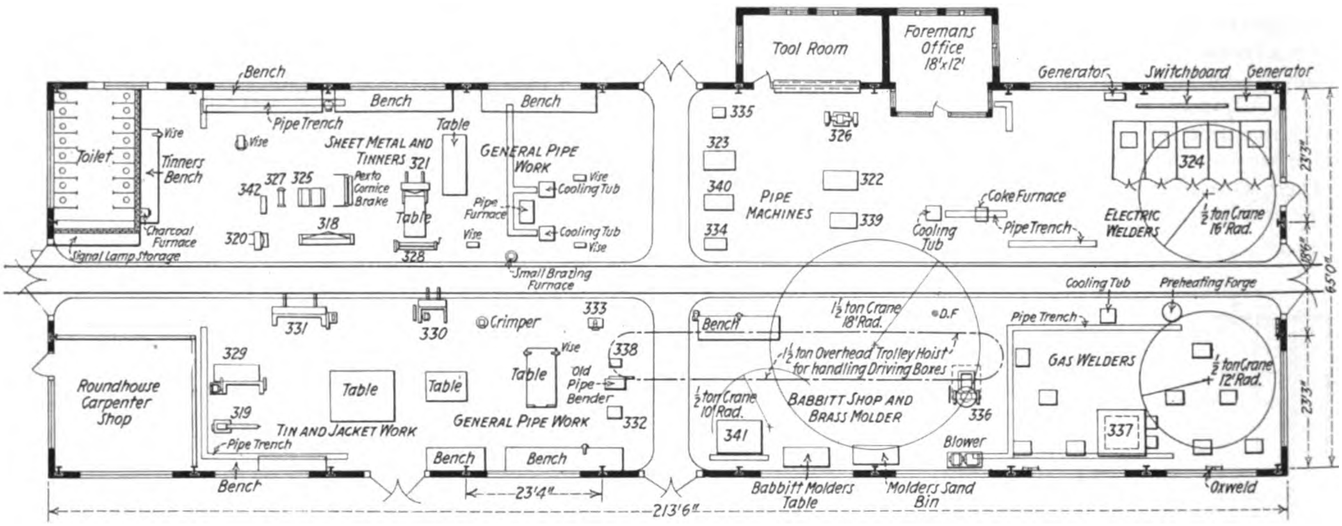
15—1 100-ton driving box press
16—1 54-in. boring mill
17 and 18—2 42-in. boring mills
19—1 36-in. pillar shaper special for driving box work
20—1 36-in. special railway draw cut shaper
21—1 36-in. draw cut shapers
22—1 23-in. draw cut shaper
23—1 32-in. draw cut shaper
24—1 60-in. radial drill
25—1 24-in. upright drill
26—1 36-in. x 36-in. x 12-ft. planer
27—1 3-in. x 24-in. double grinder

Tool reference number

56—1 high duty vertical milling machine
57—1 6-ft. radial drill press
58—1 link grinder
59—1 24-in. upright drill press
60—1 26-in. upright drill press
61—1 30-in. x 12-in. planer
62—1 12-in. slotter
63—1 24-in. draw cut shaper

MISCELLANEOUS MACHINES, NOT ASSIGNED TO SPECIAL GANGS, AVAILABLE FOR ALL WORK

64—1 1½-in. rod and bolt cutter
65—1 high duty miller
66—1 1½-in. vertical miller
67—1 two-spindle drill press
68, 69 and 70—3 24-in. upright drill presses
71—1 26-in. upright drill press
72 and 73—2 13-in. sensitive drill presses
74—1 6-ft. radial drill press
76—1 10-in. cold saw
77—1 30-in. x 24-ft. engine lathe
78—1 26-in. x 16-ft. engine lathe
79—1 25-in. x 14-ft. engine lathe
80—1 24-in. x 12-ft. engine lathe
81—1 20-in. x 10-in. engine lathe
82—1 25-in. x 10-in. chucking lathe
83—1 21-in. x 8-ft. chucking lathe
84—1 36-in. x 16-in. engine lathe
85—1 32-in. x 12-ft. engine lathe
86—1 26-in. x 12-ft. engine lathe
87—1 single dry grinder
88—1 24-in. x 16-ft. engine lathe
89—1 24-in. x 16-ft. engine lathe
90 and 91—2 32-in. x 15-ft. engine lathe
92—1 24-in. x 14-ft. engine lathe
93—1 20-in. x 8-ft. engine lathe
94—1 18-in. x 8-ft. engine lathe
95 to 98, incl.—4 3-in. x 24-in. double dry grinder
99—1 universal tool grinder
100—1 48-in. grind stone
101—60-in. x 16-ft. planer
102—36-in. x 12-ft. planer
103—30-in. x 8-ft. planer
104—1 14-in. slotter
105—1 32-in. crank shaper
106—1 30-in.—32-in. draw cut shaper
107—1 50-in. boring mill
108—1 37-in. boring mill
109—1 horizontal miller
110—1 horizontal boring machine



The pipe, tin and welding shop

GUIDES, PISTON AND CYLINDER BUSHINGS

28 and 29—2 42-in. boring mills
30—1 54-in. boring mill
31 and 32—2 36-in. x 16-ft. engine lathes
33 and 34—2 32-in. x 15-ft. engine lathes
35—1 piston rod grinder
36—1 48-in. heavy duty face (guide) grinder
37—1 6-ft. radial drill press
38—1 nut facer
39—1 3-in. x 24-in. double dry grinder

MAIN AND SIDE ROD GANG MACHINERY

40—1 24-in. x 12-ft. engine lathe
41—1 heavy duty milling machine
42—1 6-ft. radial drill press
43—1 5-ft. radial drill press
44 and 45—2 high duty upright drill presses
46—1 20-in.—24-in. slotter
47—1 15-in. slotter
48—1 slot milling machine
49 and 50—2 two-spindle drilling machines
51—1 bushing press
52—1 surface grinder

VALVE AND LINK MOTION GANG

53 and 54—2 horizontal drilling and boring machines
55—1 high duty vertical milling machine

BRASS AND BOLT GANG

111—1 6½-in. x 24-in. turret lathe
112—1 3½-in. x 24-in. turret lathe
113—1 3-in. x 36-in. turret lathe
114—1 2¼-in. x 36-in. turret lathe
114-A—1 2½-in. x 36-in. turret lathe
115—1 2¼-in. x 24-in. turret lathe
116—1 2-in. x 24-in. turret lathe
117 and 118—2 No. 3 flat turret lathes
119—1 2-in. automatic screw machine
200—1 1½-in. single head bolt cutter
201—1 2-in. double head bolt cutter
202 and 203—2 bolt centering machines
204 and 205—2 6-in. x 16-in. bolt lathes
206 to 209, incl.—4 5-in. x 16-in. bolt lathes
210 and 211—2 nut facers
212—1 16-in. power hack saw
213 and 214—2 single dry grinders

ERECTING BAY

215 to 218, incl.—4 3-in. x 24-in. double dry grinders
6 portable electric welding machines
1 14-in. x 6-ft. portable engine lathe

TOOL ROOM

219—1 No. 3 universal belt driven milling machine
220—1 No. 2 universal belt driven milling machine

Tool reference number
221—1 18-in. x 8-ft. belt driven engine lathe
222—1 20-in. x 10-ft. belt driven engine lathe
223—1 No. 2 belt driven universal grinding machine
224—1 3/16-in. x 16-in. belt driven die grinder
225—1 2-in. x 14-ft. double dry belt driven tool grinder
226—1 12-in. x 36-in. belt driven universal grinder
227—1 14-ft. sensitive drill press, belt driven
228—1 No. 4-A belt driven milling machine
229—1 24-in. x 16-ft. motor driven engine lathe
230—1 No. 14, belt driven universal grinder
231—1 3½-in. belt driven drill grinder
232—1 20-in. double motor driven tool grinder
233—1 32-in. motor driven drill press
234—1 hydraulic hand press

AIR ROOM

235—1 21-in. x 10-ft. belt driven engine lathe
236—1 16-in. x 6-ft. belt driven brass lathe
237—1 18-in. x 6-ft. belt driven brass lathe
238—1 14-in. sensitive drill press, belt driven
239—1 9-in. x 3-ft. 6-in. belt driven bench lathe
240—1 valve grinding lathe, belt driven
241—1 1½-in. x 10-in. double bench grinder, belt driven
242—1 1½-in. x 10-in. grinder and buffer, belt driven
243—1 motor driven cylinder grinding machine
244—1 20-in. x 10-ft. motor driven engine lathe
245 and 246—2 18½-in. x 6-ft. motor driven brass lathes
247—1 24-in. motor driven upright drill press

BOILER SHOP

248—1 20-ft. bending roll
249—1 10-ft. bending roll
250—1 5-ft. 6-in. hand power bending roll
251—1 48-in. combination universal double end punch and shear
252—1 1⅛-in. x 60-in. double end punch and shear
253—1 horizontal flange punch
254—1 6-ft. radial drill press
255—1 42-in. upright drill press
256—1 two-spindle drill press
257—1 pneumatic cold flanging machine
258—1 10-ft. pneumatic flanging clamp
259—1 20-ft. pneumatic flanging clamp
260—1 ½-in. x 4-in. by 4-in. angle iron bending roll
261—1 ⅜-in. x 12-ft. cornice brake
262 to 264—3 3-in. x 24-in. double dry grinders
264-A—1 12-ft. x 12-ft. oil burning plate furnace
264-B—1 oil burning flange furnace
265—1 2-in. double head bolt cutter
266—1 1½-in. double head bolt cutter
267—1 four-spindle staybolt cutter
268—1 five-spindle staybolt drilling machine
269—1 38-in. band saw
270—1 single surfacer
271—1 universal saw bench
272—1 staybolt nicking machine
6 portable rivet heaters
See blacksmith shop drawing for staybolt department machinery.

BLACKSMITH SHOP

273 and 274—2 motor driven air blowers
275—1 4,000-lb. steam hammer
276—1 2,000-lb. steam hammer
277 to 279—3 1,500-lb steam hammers
280—1 1,100-lb. steam hammer
281—1 250-lb. steam hammer
282—1 4-in. forging machine
283 and 284—2 2½-in. forging machines
285—1 20-in. bulldozer
286—1 18-in. air bulldozer
287—1 double end large punch and shear
288 and 289—2 3-in. x 24-in. double grinders
290 and 291—2 5-in. x 7-ft. 6-in. oil burning furnaces for steam hammers
292 and 293—2 bolt forging furnaces
295—1 case hardening furnace
296—Spring furnace
297—bulldozer furnace
298 to 317, incl.—20 coal forges

PIPE AND TIN SHOP

318—1 8-in. hand power cornice brake
319—1 24-in. rotary shear
320—1 30-in. foot power shear
321—1 42-in. foot power shear
322—1 8-in. pipe threading and cutting machine
323—1 2-in. pipe threading and cutting machine
324—1 four-man electric welding machine
325—1 42-in. hand power bracket and folder
326—1 3-in. x 24-in. double dry grinder, motor driven
327—1 1¼-in. x 30-in. slip roll forming machine, hand power
328—1 4-in. x 42-in. slip roll forming machine, hand power
329—1 5/32-in. multiple punch, motor driven
330—1 42-in. motor driven shear
331—1 8-ft. motor driven shear
332—1 1-in. and 2-in. hand power pipe bender
333—1 1½-in. to 4-in. hydraulic pipe bender
334—1 6-in. pipe cutting machine motor driven
335—1 motor driven drill press
336—1 42-in. brass melting furnace complete with blower
337—1 12-ft. x 12-ft annealing furnace for welding department
338—1 hand punch
339—1 2-in. pipe threading machine
340—1 1½-in. pipe threading machine
341—1 babbitt furnace
342—1 small hand circle shear

FLUE SHOP

Electric Welding—2¼-in. tubes
2 motor driven flue cutting machines
1 Belt flue polishing machine, motor driven
1 double dry motor driven grinder
1 flue welding furnace for small flues
1 pneumatic flue swedger
1 flue testing machine combined with
1 motor driven flue cutting machine

Oil Welding—2¼-in. tubes
2 Flue welding furnaces for small flues
1 3-in. motor driven hot saw
1 flue roller welding machine, motor driven
1 pneumatic flue swedger
1 testing machine combined with
1 motor driven flue cutting machine

Oil Welding—5½-in. Superheater Flues
2 flue welding furnaces for superheater flues
1 flue roller welding machine, motor driven
1 McGrath pneumatic flue swedger
1 testing machine combined with
1 motor driven flue cutting machine
1 Automatic safe end cutting machine, motor driven
2 motor driven dry drum rattlers

mer and several single frame hammers, one of 2,000 lb. capacity, and four of 15,000-lb. capacity, and in addition several smaller hammers. The shop is equipped with one 4-in. forging machine and two 2½-in. forging machines together with two bulldozers. All the hammer and bolt furnaces are oil fired, the double frame hammer having a locomotive type boiler above the furnace for generating steam. There are 17 coal fired forges in the shop. The blast for both the oil burning and the coal fired furnaces is furnished by two No. 7 blowers with direct connected motors. The blast carried at the blowers is at 15 ounces pressure and is distributed overhead by galvanized iron pipes to the forges, and underground in cast iron pipes.

Across the width of the shop for a distance of one panel in length is a space devoted to bolt finishing and here are placed two bolt cutters as well as a four-spindle staybolt machine of the vertical automatic type, and staybolt drilling and nicking machines. The machines are conveniently located here for the reason they can thread the bolts after they come from the blacksmith shop ready for delivering to the boiler and machine shops by shop trucks. There is a push car track down the center of the shop which connects the blacksmith shop with the machine shop for the purpose of handling very heavy forgings from the machine shop. However, most of the material is handled by storage battery or gasoline driven shop trucks on a concrete road which is laid down the center and to either side of the central push car track. There is also a concrete road crossing the shop near the center. The floor of the blacksmith shop is of cinders. Outside of the blacksmith shop and parallel to it are sheds for the storage of bar iron. These sheds are 24 ft. in width and 300 ft. in length, and in one end of the sheds are located bins for blacksmith shop coal.

Tin, pipe and welding shop

The tin, pipe, and welding shop is located between the blacksmith shop and the roundhouse, and is also connected with the machine shop by a push car track which enters panel No. 18 of that shop. The tin shop is equipped to handle all welding, tin, babbitt, and brass work, and in addition can do some work on shop order for the car department. As shown by the list of machinery this shop is well provided with equipment for such work.

The locomotive parts for brass and babbitt liners are delivered to and from the building by shop trucks. The brass hub liners are poured directly on the boxes from a 42-in. Swartz oil fired brass furnace; the boxes being handled by a 1½-ton overhead trolley hoist which also conveys the ladles. The east end of the tin shop is devoted to welding work which makes it convenient as this end of the shop faces onto the material platform which is between the tin shop and machine shop. The parts to be welded are delivered by an overhead crane in or near the welding booths. On the north side of the shop there are connections for electric welding, and on the south side there are three connections for gas welding. There is also provided a 6-ft. by 6-ft. preheating furnace and two preheating forges.

Outside of the tin shop are storage platforms with

racks for the storage of pipe and locomotive jackets. There is also a separate lye vat for cleaning the locomotive jackets.

The electric power for operating this shop is purchased from the Southern California Edison Company. However, the steam is generated by four 300-hp. water tube boilers located in the new powerhouse. Compressed air is furnished by two motor-driven air compressors of 3,500 cu. ft. capacity each, and one steam driven compressor of 2,000 cu. ft. capacity. Also, located in the power house are two motor driven generating sets for converting current from a.c. to d.c. to operate the large cranes and reversing planer in the machine shop, as well as some other machinery operating on direct current. The entire plant is piped for gas welding; acetylene is generated on the shop grounds in a building provided for that purpose, and the oxygen is supplied from portable pressure tanks which are connected to a manifold in the gas generating plant.

The entire locomotive department is supplied with fuel oil for furnaces and forges by an oil line which makes a complete circulating system throughout all the shops. This oil line is laid underground in tile pipe and is paralleled by a steam line for keeping the oil warm. Manholes are located at convenient distances so that the pipe can be drawn out and repaired. The fuel oil supply reservoir with pumps is located between the blacksmith shop and the power house.

For the convenience of the employes the shop is liberally supplied with wash room, toilet, and locker facilities. All lavatories are arranged so that men can wash under running water, and the locker rooms are equipped with steel lockers of liberal dimensions. There is also an apprentice

The well-lighted boiler shop machine bay

school room 30 by 56 ft., as well as a shopmen's assembly room.

A fire department building was constructed and equipped with modern motor-driven fire trucks which operate over concrete roadways connecting all departments.

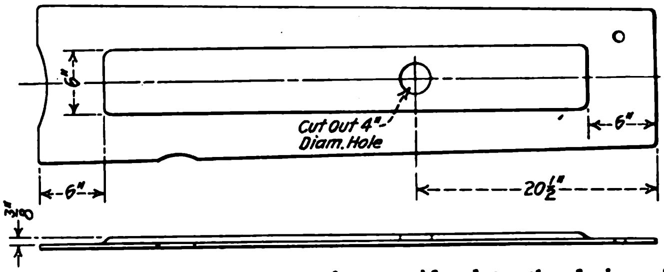
The mechanical equipment was designed and laid out under the general supervision of John Purcell, assistant to vice-president, by B. P. Phelps, engineer of shop extensions, collaborating with H. S. Wall, mechanical superintendent of the Coast Lines, and A. G. Armstrong and H. Bruce Harmon, superintendent and assistant superintendent, respectively, of the San Bernardino shops.

Making enginehouse booster repairs easier

By A. T. E.

IN order to make many of the heavy repairs to locomotive boosters, the eccentric rods of the booster engine must be removed and because of the close clearance between the crank case side plates and the eccentric crank and rachet arm pins, the side plates must either be removed or loosened and spring out. The removal and replacing of these plates while the booster is still under the locomotive is not only a disagreeable job, but with the plates sprung away it is difficult to be sure the gasket is perfectly clean and oil tight.

The side plates, however, need not be removed if the method outlined here is followed. When locomotives equipped with boosters go through the back shop for repairs, the booster side plates should be removed and given



Sketch showing a booster crank case side plate, the design of which facilitates the work of maintenance

a 3/8-in. offset, or dish, according to the dimensions shown in the sketch. Dies can be designed to make this offset under a press and either the old plates used or new ones made. If the old plates are used it is suggested that short pins or studs, be screwed into the bottom die to correspond to the bolt holes in the plate. The plate can then be held down by nuts, or preferably by an air clamp working in conjunction with the top die. If new plates are made, which is more desirable, a considerable saving can be made by pressing the required number of plates at one time, using no studs or air clamps in this operation. The holes can then be laid off to a template and the drilling, or punching, all done at one time. As there is always a demand for such plates around a back shop, the original side plates need not be scrapped, but can be cut up for shoe and wedge liners, guide liners, etc.

The plates shown in the sketch is for the left side of the crank case and is known as booster part No. 21522. The 4-in. diameter hole shown is used to facilitate the removal of the crosshead pin. The small hole shown in the upper back corner of the plate is tapped for an elbow through which the crank case is oiled.

While the application of this type of side plate is particularly helpful in making heavy repairs in the enginehouse, it will also be found helpful at the back shop where the booster is out from under the locomotive. The side plate gaskets rarely leak when kept properly tightened and their removal at the back shop should not be necessary unless the valves are to be run over in the manner indicated in the booster instruction book.

ATCHISON, TOPEKA & SANTA FE.—Plans have been prepared for the construction of a 43-stall enginehouse, several small shop buildings and extensive track facilities at Emporia, Kan. The project is estimated to cost approximately $500,000. The construction of the enginehouse and related facilities constitutes the second unit in the Santa Fe's development of a terminal at Emporia.

D. L. & W. has effective scheduling system

Increased production has been obtained by setting a "bulls-eye" for classified repairs

By E. A. Koschinske

Superintendent of shops, Delaware, Lackawanna & Western, Scranton, Pa.

REALIZING that it is essential to know just how long it should take to overhaul a locomotive with the least cost of operation, a simple but effective shop schedule has been developed within the past year at the Scranton locomotive shops of the Delaware, Lackawanna and Western. It was realized that in order to secure a desired output with the least possible cost of operation some effective plan would have to be developed for the handling of locomotives for classified repairs which would not be too elaborate or unwieldy. In beginning an analysis, the shop management made a detail study selecting each step or major operation in its proper sequence which would produce the desired results, anticipating what material would be needed and reducing lost motion, and corelating the work of the various departments involved so that the completion of each major operation would dovetail into the others.

In developing this schedule a bogie time constant was developed wherein the "bulls-eye" (the days allotted for completion of each classified repair) was such as to require a perfect corelation between the factors, time, material, manload and cost. The measuring stick used in planning this schedule was the piece work rate established for each operation in repairing of the locomotive based on an ideal manload for a Class Five repair and supplemented by research extending several years back.

It was developed that 10 eight-hour days was an ideal shop time constant for a Class Five repair, which calls for tires turned or new, general repairs to machinery and necessary repairs to the boiler, for any class of locomotive. The ideal manload in keeping with the carrying types of locomotives is determined by the immediate department foreman, his action being governed solely by the advance information which is given of work to be done together with the time it is to be performed in.

This research developed that giving a Class Five repair a factor of one, the following values were developed for the other classified repairs, namely: Class Four 1.36, Class Three 1.36, Class Two 2.77 and Class One 2.77. In cases of exceptionally heavy boiler work on a Class Three repair a factor of 1.6 was developed, giving a true time value of 10 days to factor one or Class Five repairs and maintaining the above ratio. We have the following time values for classified repairs:

Class	Days
Five	10
Four	14
Three	14
Three (heavy)	16
Two	28
One	28

Likewise 28 actual working days are allowed for the application of a superheater, stoker or valve gear.

A key to the major schedule, Table I, was formulated wherein 28 major operations in their proper sequence are shown, starting from the time of dismantling the locomotive and following up step by step until the repair work is finished. This is the predetermined time given to complete major operations as outlined to the department or assistant foreman. The planning of work in this manner aids materially in assisting the foremen properly to assign their employees to the work in hand and gives definite instructions to the foremen in each department as to when their operations must be completed. This does away with the practice used in most shops where the schedule is planned each month and all efforts are centered on *output,* losing sight entirely of the *input,* with the result that at the end of the month it is found that their output is below the estimate on account of no actual shop production control being in effect.

Table I—Key used in connection with major schedule

Major operations	Cls. 5 10 Days	Cls. 3 & 4 14 Days	Cls. 3 16 Days	Cls. 2-3C 3B-D 28 Days
Unwheeled	1	1	1	1
Pipe work off	1	1	1	1
Jacket and lagging off	2	2	2	2
Motion work in vat	2	2	2	2
O.K. for boilermakers	2	2	2	2
All material delivered	3	3	3	3
Spring rigging from smith shop	4	6	8	10
Truck work from smith shop	4	6	8	10
Brake work from smith shop	4	6	8	10
Flues out	..	3	3	3
Boxes from foundry	5	5	5	5
Cab work	6	8	9	22
Bolting	6	9	10	22
Shoes and wedges L.O.	6	8	10	22
Wheels and boxes	7	8	10	22
Rods complete	7	8	10	22
Pistons, crossheads and guides	7	11	13	23
Boiler test	7	10	13	23
Jacket and lagging O.K.	8	11	14	24
Spring rigging O.K.	7	10	11	23
Steam chests	7	9	11	22
Engine wheeled	8	10	12	24
Motion work	8	10	12	23
Brake work	9	13	15	27
Tank out	9	13	15	25
Pipe work up	10	14	16	28
Engine painted	10	14	16	28
Engine out	10	14	16	28

In making up the key used in connection with the master schedule great care was exercised in the order given and the time allowed was based on the form, or graphic chart, shown in Table I, which shows the exact sequence and interlocking of major operations on the input side. Table I was used at first in developing the scheduling system, having particular reference to the input.

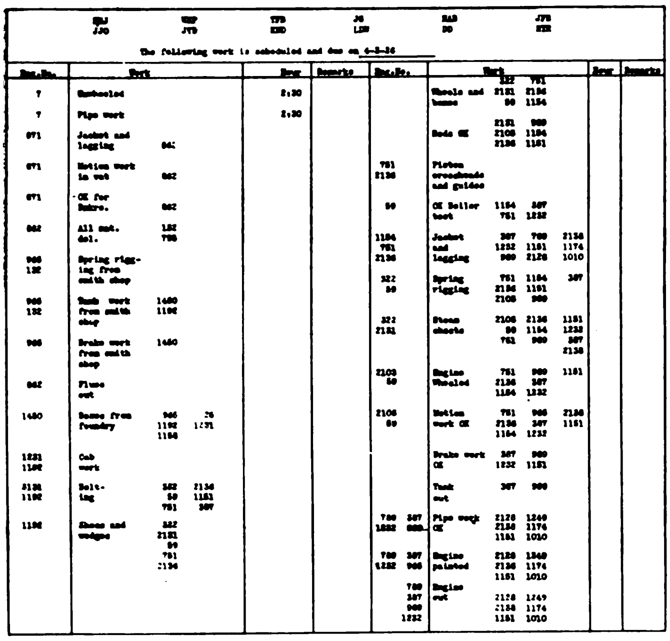
Sixty days prior to the shopping of locomotives, which is determined by federal requirements, tire wear and general condition, the major defects and shop requirements are shown on a form made out by the respective master mechanics a copy of which is sent to the superintendent of locomotive shops. These forms show the unusual conditions which have been developed and allow ample time for furnishing all necessary material, special appliances, etc.

When a locomotive is received for classified repairs, a report of its condition is received, the analysis of which determines what class of repairs are to be made. The

class of repair is determined and a form illustrated is filled out on which all necessary information is given, namely: the number of the locomotive, the date and time placed in the shop, predetermined dates allowed for each major operation, the class of repair, the number of actual working days, federal requirements, such as hydrostatic test, renewal of staybolt caps, flues, jacket and lagging, and boiler wash.

A copy of this form is furnished to each department foreman prior to placing the locomotive in the shop. The information given on this form is so complete that each department knows in advance just how long it should take to overhaul a locomotive. It has been proved that the various department and assistant foremen can better visualize their work as they know the length of time allotted to them and when their work should be ready.

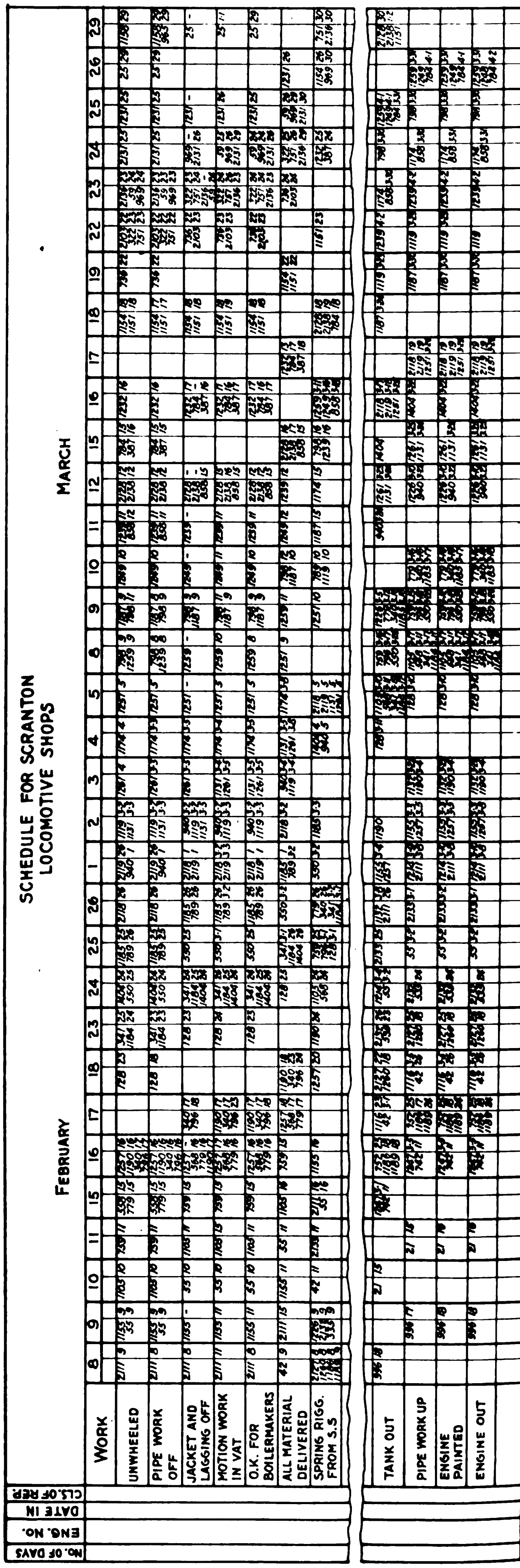
All the information placed on the above form when the locomotive arrives in the shop is incorporated on a master schedule chart, on which the completion of each major operation is checked and a record made as to



Form known as the "Yellow Dog" which shows the progress of repair work on each locomotive going through the shop

whether it was performed in the prescribed time or not. In addition to this form there is an additional form which is issued daily by the shop general foreman's office and a copy delivered to each department foreman, calling to his attention the operations that are expected to be completed by his department that day. The form, also illustrated, is commonly referred to by the supervisors as the "yellow dog," it being typed on yellow paper, because "go where they will it persists in following them and can't be shaken off."

Each department foreman at the close of the day's work returns this form to the general foreman's office with his written comments thereon as to whether or not the major operations due that date were completed, and if not, why. When the department foremen check the major operations on this form they not only check those that they are directly responsible for, but also those major operations which should be completed in their proper sequence and delivered to the various departments concerned. When this form or "yellow dog" is turned into the general foreman's office by each department foreman it is analyzed and those operations which were not com-



Form showing the number of locomotives for which each major operation is complete d each day

SUMMARY OF THE SCRANTON LOCOMOTIVE SHOP SCHEDULE
MARCH 1926

TOTAL NUMBER OF ACTUAL WORKING DAYS FOR MONTH 23. HOURS PER DAY 8.

Engine Number	Date in Shop	No. of Days Scheduled	Cls. of Rep'rs.	Unwheeled	Pipe Work Off	Jacket and Lagging Off	Motion Wk. in Vat	O.K. for Boilermkrs.	All Mtl. Del.	Spring Rigg. from S.S.	Truck Work from S.S.	Brake Work from S.S.	Flues Out	Boxes from Foundry	Cab Work	Bolting	Shoes and Wedges L.O.	Wheels and Boxes	Rods O.K.	Pistons, Xhds. and Guides	Boiler Test	Jacket and Lagging Up	Spring Rigg. Up	Steam Chests	Engine Wheeled	Motion Work O.K.	Brake Work Up.	Tank Out	Pipe Work Up	Engine Painted	Engine Out	No. of Days Overdue	Total No. of Days in Shop	Remarks
2132	2-1	14	3	2-2 / 2-3	2-2 / 2-2	2-2 / –	2-2 / 2-3	2-2 / 2-2	2-3 / 2-8	2-9 / 2-9	2-9 / 2-9	2-9 / 2-9	2-3 / 2-8	2-8 / 2-10	2-11 / 2-11	2-15 / 2-15	2-11 / 2-17	2-11 / 2-17	2-11 / 2-11	2-17 / 2-23	2-16 / 2-25	2-17 / 2-25	2-16 / 2-23	2-15 / 2-17	2-16 / 2-24	2-16 / 2-23	2-23 / 2-25	2-23 / 2-26	2-24 / 3-1	2-24 / 3-1	2-24 / 3-1	3	17	Flues not out and Mtl. not stripped acct excessive stripping on other engs.
2133	2-1	16	3	2-2 / 2-3	2-2 / 2-2	2-2 / –	2-2 / 2-8	2-2 / 2-2	2-3 / 2-8	2-11 / 2-11	2-11 / 2-11	2-11 / 2-11	2-3 / 2-3	2-8 / 2-11	2-15 / 2-15	2-16 / 2-18	2-16 / 2-18	2-16 / 2-23	2-16 / 2-17	2-23 / 2-23	2-23 / 2-26	2-24 / 2-26	2-17 / 2-24	2-17 / 2-18	2-18 / 2-25	2-18 / 2-24	2-25 / 2-26	2-25 / 2-25	2-26 / 3-1	2-26 / 3-2	2-26 / 3-1	1	17	Stripping not cov. promptly acct of excessive Strip. on other eng. Flues delayed in B.S
55	2-8	10	5	2-9 / 2-9	2-9 / 2-9	2-10 / 2-10	2-10 / 2-10	2-10 / 2-10	2-11 / 2-11	2-15 / 2-15	2-15 / –	2-15 / 2-15	2-11 / –	2-16 / 2-16	2-17 / 2-17	2-17 / 2-18	2-17 / 2-18	2-18 / 2-23	2-18 / 2-18	2-18 / 2-23	2-18 / 2-24	2-23 / 3-1	2-18 / 2-23	2-18 / 2-23	2-23 / 2-25	2-23 / 2-26	2-24 / 3-1	2-24 / 3-2	2-25 / 3-2	2-25 / 3-2	2-25 / 3-2	3	13	Delayed acct. Throttle Work Mach. not ready for test
1155	2-4	14	4	2-9 / 2-9	2-9 / 2-9	2-9 / –	2-9 / 2-11	2-9 / 2-9	2-10 / 2-11	2-16 / 2-16	2-16 / 2-16	2-16 / 2-16	2-10 / 2-10	2-15 / 2-15	2-18 / 2-18	2-23 / 2-26	2-18 / 2-18	2-18 / 2-18	2-18 / 2-18	2-25 / 2-25	2-24 / 3-1	2-25 / 3-2	2-24 / 2-26	2-23 / 2-25	2-24 / 2-26	2-24 / 2-26	3-1 / 3-1	3-1 / 3-4	3-2 / 3-3	3-2 / 3-3	3-2 / 3-3	1	15	Flues delayed in B.S. Bolting acct. Mach. Shop
1190	2-15	10	5	2-16 / 2-16	2-16 / 2-16	2-16 / 2-17	2-17 / 2-17	2-17 / 2-17	2-18 / 2-18	2-23 / 2-24	2-23 / 2-24	2-23 / 2-23	2-18 / –	2-24 / 2-24	2-25 / 2-25	2-25 / 2-25	2-25 / 2-26	2-26 / 2-26	2-26 / 3-1	2-26 / 3-1	2-26 / 3-2	3-1 / 3-3	2-26 / 3-1	2-26 / 3-2	3-1 / 3-2	3-1 / 3-4	3-2 / 3-3	3-2 / 3-3	3-3 / 3-4	3-3 / 3-4	3-3 / 3-4	1	11	Motion Work and Boiler Work
1247	1-19	16	3	1-21 / 1-21	1-21 / 1-21	1-21 / 1-21	1-21 / 1-25	1-21 / 1-21	1-25 / 1-25	2-2 / 2-2	2-2 / 2-2	2-2 / 2-2	1-25 / 2-2	1-27 / 1-27	2-3 / 2-4	2-4 / 2-4	2-4 / 2-4	2-4 / 2-4	2-4 / 2-4	2-10 / 2-10	2-10 / 3-3	2-11 / 3-5	2-8 / 2-23	2-8 / 2-9	2-9 / 2-23	2-9 / 2-9	2-15 / 2-24	2-15 / 3-1	2-16 / 3-5	2-16 / 3-5	2-16 / 3-5	11	27	Delayed acct. of excessive Boiler Work
1116	1-21	16	3	1-25 / 1-25	1-25 / 1-25	1-26 / 1-26	1-26 / 1-27	1-26 / 1-26	1-27 / 1-27	2-4 / 2-4	2-4 / 2-4	2-4 / 2-4	1-27 / 1-1	2-1 / 2-2	2-8 / 2-8	2-9 / 2-17	2-9 / 2-9	2-9 / 2-8	2-9 / 2-9	2-15 / 2-15	2-15 / 3-2	2-16 / 3-5	2-10 / 2-16	2-10 / 2-11	2-11 / 2-17	2-11 / 2-11	2-17 / 2-18	2-17 / 2-23	2-18 / 3-5	2-18 / 3-5	2-18 / 3-5	9	25	Wheeling delayed acct. waiting on Sh. for Dr. Springs. Test delayed acct. Flues, Slow in B.S.
1257	2-11	10	5	2-16 / 2-16	2-16 / 2-16	2-16 / –	2-16 / 2-17	2-16 / 2-16	2-17 / 2-18	2-18 / 2-20	2-18 / 2-18	2-18 / 2-20	2-17 / –	2-23 / 2-24	2-24 / 2-24	2-24 / 2-26	2-24 / 2-26	2-25 / 3-1	2-25 / 2-25	2-25 / 3-5	2-25 / 2-26	2-26 / 3-4	2-25 / 3-3	2-25 / 3-2	2-26 / 3-4	2-26 / 3-4	3-1 / 3-4	3-1 / 3-3	3-2 / 3-5	3-2 / 3-5	3-2 / 3-8	4	14	Bolting acct. Mach. Shop Motion Work Slow. Pistons delayed acct. waiting on Sh. for Dunbar Pa[cking]
2111	2-3	14	4	2-8 / 2-9	2-8 / 2-8	2-8 / 2-8	2-8 / 2-11	2-8 / 2-8	2-9 / 2-15	2-15 / 2-16	2-15 / 2-15	2-15 / 2-15	2-9 / 2-15	2-11 / 2-15	2-17 / 2-17	2-18 / 2-18	2-17 / 2-24	2-17 / 3-2	2-17 / 2-18	2-20 / 2-24	2-23 / 3-4	2-24 / 3-8	3-23 / 3-1	2-18 / 2-18	2-23 / 3-2	2-23 / 2-26	2-26 / 3-3	2-26 / 2-26	3-1 / 3-8	3-1 / 3-8	3-1 / 3-8	5	19	Stripping and del. Slow acct. excess. stripping on other Engs. Flues Slow. Jacket and Lagg. Slow
1214	1-11	28	3B	1-13 / 1-12	1-13 / 1-13	1-13 / 1-18	1-13 / 1-13	1-13 / 1-13	1-14 / 1-14	1-27 / 1-27	1-27 / 1-27	1-27 / 1-27	1-14 / 1-20	1-19 / 1-21	1-17 / 2-17	2-17 / 2-17	2-17 / 2-9	2-17 / 2-17	2-17 / 2-17	2-18 / 3-5	2-18 / 3-3	2-22 / 3-9	2-18 / 3-3	2-17 / 2-17	2-22 / 3-3	2-18 / 2-18	2-26 / 3-4	2-24 / 3-4	3-1 / 3-9	3-1 / 3-10	3-1 / 3-10	7	35	Excessive Boiler Work. Pistons held up acct. waiting on Dunbar packing
1226	1-26	28	3B	1-28 / 1-28	1-28 / 1-28	1-28 / 1-28	1-28 / 2-1	1-28 / 1-28	2-1 / 2-2	2-9 / 2-9	2-9 / 2-9	2-9 / 2-9	2-1 / 2-8	2-3 / 2-4	3-4 / 3-4	3-4 / 2-25	3-4 / 2-25	3-4 / 3-4	3-4 / 3-4	3-5 / 3-8	3-5 / 3-7	3-8 / 3-8	3-5 / 3-5	3-4 / 2-25	3-9 / 3-5	3-5 / 3-5	3-11 / 3-10	3-9 / 3-5	3-12 / 3-10	3-12 / 3-10	3-12 / 3-10	(2)	26	
128	2-17	10	5	2-18 / 2-23	2-18 / 2-18	2-23 / 2-23	2-23 / 2-24	2-23 / 2-23	2-24 / 2-25	2-25 / 3-1	2-25 / –	2-25 / 2-26	2-24 / –	2-26 / 3-4	3-1 / 3-1	3-1 / 3-5	3-1 / 3-4	3-2 / 3-4	3-2 / 3-3	3-2 / 3-4	3-2 / 3-2	3-3 / 3-8	3-2 / 3-5	3-2 / 3-4	3-3 / 3-8	3-3 / 3-8	3-4 / 3-10	3-4 / 3-11	3-5 / 3-10	3-5 / 3-10	3-5 / 3-10	3	13	Bolting not cov. promptly Test delayed acct. Mach.
568	2-11	14	3	2-15 / 2-15	2-15 / 2-15	2-16 / 2-16	2-16 / 2-16	2-16 / 2-16	2-17 / 2-17	2-24 / 2-24	2-24 / 2-24	2-26 / 2-24	2-17 / 2-17	2-23 / 2-23	2-26 / 2-26	3-1 / 3-2	2-26 / 3-1	2-26 / 3-2	2-26 / 3-3	3-3 / 3-4	3-2 / 3-8	3-3 / 3-9	3-2 / 3-8	3-1 / 3-4	3-2 / 3-8	3-2 / 3-5	3-5 / 3-10	3-5 / 3-11	3-8 / 3-11	3-8 / 3-11	3-8 / 3-11	3	17	Flues delayed in B.S.

This form showing the sequence of operations is maintained by the shop general foreman

pleted as scheduled are noted and this information is given to both the general foreman and superintendent of shops. They, in turn, personally check up the cause of any delay and take necessary corrective action. This has proved very effective as it keeps the shop supervision keyed up and advised as to the progress of work.

The form known as a summary schedule is maintained by the shop general foreman showing the exact sequence of major operations as found on the individual locomotive form. As locomotives are received in the shop the numbers are entered on the summary schedule together with the date of arrival in the shop, class of repair and number of scheduled shop days contingent on the class of repairs. Horizontally across this form under each operation heading is found the predetermined completion date or "bulls-eye" for each major operation, and upon the completion of each major operation the date is shown directly under the predetermined date. On the right hand side of this master chart is shown the number of days each locomo-

WEP JTB HRJ JJO TFB RKD JO LDW RAB DD JPB STR

The work on engine 132 in shop 3-30 at 3:30 p.m. is scheduled as follows:

Work	Date	Hr.	Rem.	Work	Date	Hr.	Rem.
Unwheeled	3-31	2:30		Wheels and boxes	4-7		
Pipe work	3-31	2:30		Rods completed	4-7		
Jacket and lagging, off	4-1	10:00		Pistons, crossheads, guides	4-7		
Motion work in vat	4-1	3:30		Boiler test	4-7		
OK for boilermakers	4-1	3:30		Jacket and lagging on	4-8		
All material delivered	4-2	3:30		Spring rigging	4-7		
Spring rigg. from smith shop	4-3			Steam chests	4-7		
Truck work from smith shop	4-3			Eng. wheeled	4-8		
Brake work from smith shop	4-3			Motion work OK	4-8		
Flues out	No			Brake work OK	4-8		
Boxes from foundry	4-6			Tank out	4-8		
Cab work	4-6			Pipe work OK	4-10		
Bolting	4-6			Eng. painted	4-10		
Shoes and wedges laid out	4-6			Eng. out	4-10		

Jacket and lagging All off
Hydro. test Yes
Caps Yes
Wash Yes
Flues Yes

Class of repairs 5
No. of days 10

Form showing the time the work on each locomotive is scheduled for each department

tive is held in the shop over the predetermined schedule, and in another column is shown the total number of days in shop. On the extreme right is a column for explaining in detail the exact causes for failure to meet the predetermined date.

Among many of the outstanding benefits derived from this form of scheduling system is the fact that it allows the chief shop executive to locate any stagnant condition in his production and he can place his finger on any unbalanced condition that may develop. This scheduling system has developed cases where several departments were undermanned, while others were overmanned, which allowed immediate correction.

A perfect rhythm and as near perfect co-operation has been created between the various departments as is possible. Sincere enthusiasm has been created among the supervisors which has percolated down through the ranks, each man knowing where he should fit to best advantage.

It may be of interest to note the reduction in the shop days that locomotives are undergoing various classified repairs. The following is the condition for the period:

Month	Behind the given predetermined time, per cent	Month	Behind the given predetermined time, per cent
March, 1925	104	August	55
April	87	September	74
May	70	October	73
June	92	November	57
July	69	December	63

This is an average for 10 months of 74 per cent behind the given predetermined schedule; in January, 1926, 56 per cent behind the given predetermined schedule, February 63 per cent and March 49 per cent.

As this scheduling system is becoming more effective there are indications of closer approach to the predetermined scheduled dates. It is also interesting to note the increasing efficiency of labor costs on a monthly basis which are as follows:

Month	Efficiency, per cent	Month	Efficiency, per cent
March, 1925	54	August	82
April	60	September	68
May	58	October	75
June	75	November	70
July	70	December	88

This gives us an average of 68 per cent efficiency in 10 months for the year 1925. In the month of January, 1926, 75 per cent efficiency; February, 1926, 90 per cent, and March, 1926, 93 per cent.

In conclusion, it might be well to say that at the Scranton locomotive shops of the Delaware, Lackawanna and Western this scheduling system has come to be an absolute necessity and within the last several months has been put in effect at all locomotive repair shops on the system.

Each month copies of the summary schedule showing the output from each shop are sent respectively to the superintendent of motive power and equipment, and to the operating vice-president and manager.

Air brake convention meets at New Orleans

Members and guests numbering 852 attend highly successful convention—51 railway supply companies exhibit devices

The Air Brake Association held its 33rd annual convention at the Hotel Roosevelt, New Orleans, La., on May 4 to 7, inclusive, and this convention was the largest and in many respects the most successful in the history of the association. The final registration was 852 members and guests, and 51 supply companies were represented in the exhibit.

A number of the reports were of exceptional value and in addition to hearing and discussing these reports the members of the association had an opportunity to study, in the exhibition hall, the fine points of practically all of the equipment encountered in their daily routine of duty. The value of the exhibit this year was strongly emphasized on the convention floor by several members who said that the technical information furnished by the engineers and experts of the supply companies has become an important feature of the convention.

Election of officers

Following the reading of reports and the discussion of new business, the association elected the following officers for the ensuing year: President, M. S. Belk, general air brake instructor, Southern, Washington, D. C.; first vice-president, H. A. Clark, general air brake inspector, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.; second vice-president, H. L. Sandhas, general inspector, Central of New Jersey, Allentown, Pa.; and third vice-president, W. W. White, supervisor air brakes, Michigan Central, Detroit, Mich. Otto Best, Nathan Manufacturing Company, New York, was returned to the position of treasurer, F. M. Nellis, Westinghouse Air Brake Company, New York, being permanent secretary. One new member was elected to the executive committee: E. C. Mann, Atlantic Coast Line.

The Air Brake Appliance Association held its annual meeting during the convention and elected the following officers: President, Fred Speer, Gustin-Bacon Manufacturing Company, Philadelphia, Pa.; and secretary-treasurer, J. H. Ainsworth, A. M. Byers Company, Pittsburgh, Pa. The terms of three of the executive committee members expired and the following were elected to take their places: C. R. Busch, Buffalo Brake Beam Com-

R. C. Burns (Pennsylvania), president

M. S. Belk (Southern), first vice-president

H. A. Clark (Soo Lines), second vice-president

H. L. Sandhas (C. R. R. of N. J.), third vice-president

pany, New York; W. A. Housten, Joseph Dixon Crucible Company, Baltimore, Md.; and R. F. Duysters, Simmons-Boardman Publishing Co., New York.

President Burns' address

Like every other division of railroad transportation, the air brake must, of necessity, keep pace with the constantly increasing developments and improvements in the more efficient and safe handling of passengers and lading. This necessitates constant vigilance in the way of practical apparatus, installation and maintenance. Many rules and regulations are essential in order that equipment from one road may be thoroughly interchangeable as to functioning and performance on another. Without such regulations we could not expect to progress, and in order that our progress may continue, it is vitally important that air brake men fulfill their duty in seeing that regulations are carried out.

When we look broadly upon the accomplishments of railroads in this country, as compared with those abroad, in facilitating exchange of freight, we have just reason to feel proud of our work. A freight car loaded in Canada can be transported to any part of this great continent without any change in its equipment or transfer of its lading.

While a healthy rivalry and competition exists among properties under separate ownership, there is no selfish division between the officers and employees of one road and those of another when it comes to matters pertaining to the common good. This is an accomplishment in which we, as air brake men, have had a prominent part, and we are, therefore, justly entitled to a feeling of pride in our vocation and in the railroad air brake department which we represent.

The safety factor, though of essential importance, is but a part of our extensive field of endeavor. The brake equipment must be equal to the demands of traffic in every particular and still render the required service as to safety.

You are aware of the efforts being made by the American Railway Association to analyze the existing equipments and the art of controlling trains by means of air brakes in general, with a view toward formulating improvements wherever possible or desirable. This is in the common interest of all railroads of the country. We shall await with much interest the results of these studies, and I bespeak for this association your whole-hearted co-operation and willingness to render any service that may be desired.

During the convention the following reports and papers were discussed: Committee report on hose coupling gages; Retaining valve testing, Central Air Brake Club; Triple valve repairs, Central Air Brake Club; Committee report on review and comments on tolerances of triple valve dimensions in repair work; Modern freight train handling, St. Louis Air Brake Club; Better insulation of steam cylinders of air compressors, by C. B. Miles; Recent improvements in passenger train braking; Committee report on brake pipe leakage; Cutting and bending of air brake pipe, Pittsburgh Air Brake Club; Committee report on recommended practice, and Train control, by George H. Wood, H. L. Sandhas and others. Abstracts of the reports bearing more particularly on the application and maintenance of air brake equipment will appear in a later issue.

Fuel convention a big success

Attendance at four-day meeting included officers of many departments—Addresses by several executives

A PROGRAM of subjects bearing on the relation to fuel economy of practically all departments of the railroad organization at the eighteenth annual meeting of the International Railway Fuel Association held at the Hotel Sherman, Chicago, May 11 to 14, received the sustained attention of one of the largest, if not the largest, attendances in the history of the organization. This attendance was made up of executives, officers from various departments, and a large number of men from engine and train service on railroads all over North America, as well as the officers and supervisors dealing specially with the purchase, inspection, distribution and use of fuel. Following out a practice which was very favorably received at last year's convention, the subjects were grouped so that those of special interest to operating men were presented on the first day; those of special interest to the accounting, engineering and purchasing departments were presented on the second day, and those of special interest to the mechanical department were presented on the third and fourth days.

The convention was called to order by the president, J. W. Dodge, Illinois Central, who, after a brief address, introduced A. E. Clift, senior vice-president of the Illinois Central. Mr. Clift in his address reviewed the accomplishments of the American railroads up to the present time and outlined some of the changes in the character of railroad development and in the relationships between the railroad and the public which have recently been taking place. He concluded by calling attention to the part which fuel organizations have played in increasing the efficiency with which the railroads have been operated during the past few years, with a reduction in fuel consumption per unit of freight service of 19.3 per cent from 1920 to 1925, and 6.5 per cent from 1924 to 1925, and corresponding reductions per unit of passenger service of 14.3 per cent and 5.3 per cent, respectively, resulting in a saving 24,467,000 tons in both branches of the service in 1925, on the basis of traffic handled in that year, as compared with 1920, and of 7,302,000 tons as compared with 1924.

D. H. Pape, assistant to executive secretary, National Coal Association, in an address on the factors affecting fuel cost and distribution, presented a comprehensive survey of the economic factors affecting the bituminous coal industry and their relationship to the railroads, in which he expressed his belief that both the mining and transportation industries have a common interest in educating the coal consuming public to an understanding of the burden which it ultimately bears as the result of excess mine capacity and excess transportation capacity because of its failure to permit the mining and transportation of its coal requirements at a uniform rate throughout the year.

Other addresses were made before the convention by

H. R. Safford, vice-president, Missouri Pacific, who spoke on engineering factors in fuel conservation; J. J. Ekin, controller, Baltimore & Ohio, who discussed accounting factors in fuel conservation; R. J. Elliott, purchasing agent, Northern Pacific, who spoke on the relation of coal to dividends, and C. E. Brooks, chief of motive power, Canadian National, who discussed some of the mechanical factors in fuel economy confronting the railroads today.

Committee reports were presented on the following subjects: Division fuel meetings, O. J. Brown (B. & M.), chairman; Recording miscellaneous fuel disbursements, B. A. McDowell (B. & O.), chairman; Fuel stations, L. J. Joffray (I. C.), chairman; Stationary plants, R. S. Twogood (S. P.), chairman; Storage of coal and fuel oil, Glenn Warner (P. M.), chairman; Inspection, preparation and analysis of fuel, Malcolm Macfarlane (N. Y. C.), chairman; New locomotive economy devices, E. E. Chapman (A. T. & S. F.), chairman; Firing practice, D. C. Buell (Railway Educational Bureau), chairman; Front ends, grates and ash pans, Prof. E. C. Schmidt (University of Illinois), chairman. Included with the report of the Committee on New Locomotive Economy Devices was a paper on back pressure as an index to fuel economy, by R. W. Retterer (Big Four), the discussion of which was carried over from the 1925 convention. During several of the sessions considerable time was also devoted to open forum discussions of various phases of the fuel economy problem of the railroads.

Other business

At the closing session of the convention the following officers were elected to serve for the coming year: President, E. E. Chapman, engineer of tests, A. T. & S. F.; vice-presidents, J. E. Davenport, superintendent, N. Y. C.; W. J. Tapp, fuel supervisor, D. & R. G. W., and T. C. Hudson, assistant general superintendent motive power, Canadian National. Four members were elected to the Executive Committee as follows: C. H. Dyson, assistant fuel agent, B. & O.; C. I. Evans, chief fuel supervisor, M.-K.-T.; V. L. Jones, assistant mechanical engineer, N. Y. N. H. & H., and L. P. Michael, mechanical engineer, C. & N. W.

The Executive Committee at a meeting following the close of the convention, decided on May 10, 1927, as the date for the commencement of the next convention, which will be held at Chicago.

The exhibit

The exhibit organized by the National Railway Supply Men's Association in connection with the meeting of the International Fuel Association, was unusually extensive this year. It was participated in by seventy companies, in addition to the parlor space provided by a number of coal companies. This was one of the largest exhibits ever held by the association.

At the meeting of the exhibiting organization held during the continuance of the exhibit, the following officers were elected for next year: President, F. S. Wilcoxen, Edna Brass Company; vice-president, F. P. Roesch, Standard Stoker Company; secretary, W. H. Harris, W. H. Harris Coal Company; treasurer, M. K. Tate, Lima Locomotive Works, Inc. Two new members of the Executive Committee were elected as follows: D. A. Witt, Detroit Lubricator Company, and E. H. Cooke, American Arch Company.

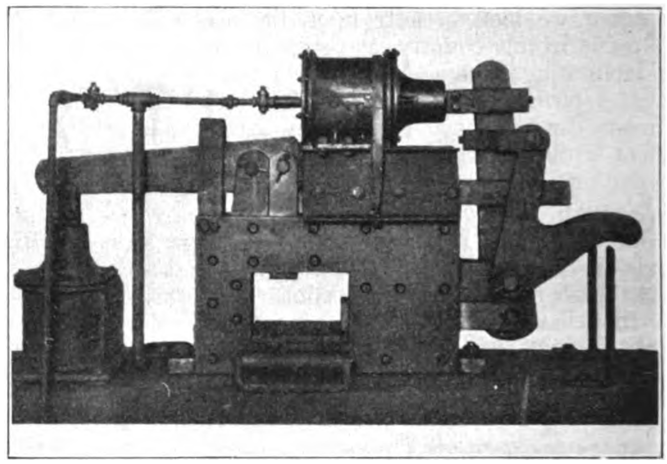
Abstracts of a number of the reports presented and discussed at the convention will appear in later issues of this magazine.

Spring banding machine

By B. J. Starke

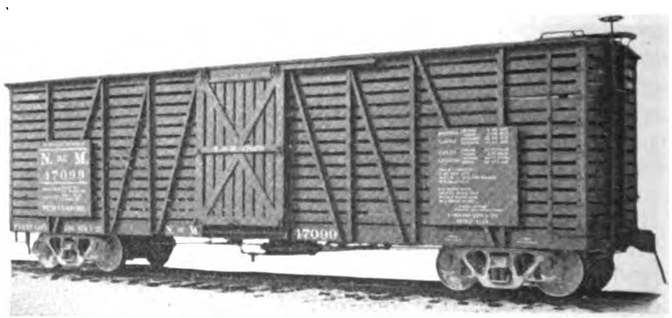
LOCOMOTIVE driving and trailer track springs require, at different times, rebanding owing to loose spring bands and shifted leaves. To do this work by hand is not only slow but the finished job is not entirely satisfactory. The machine shown in the illustration, which was made in the Chicago & North Western shops at Kaukauna, Wis., not only increased production 40 per cent over the hand method but also eliminated the trouble of loose springs, for which purpose the machine was primarily designed.

The machine was made mostly from scrap material such as parts of engine frames, an old planer bed, boiler steel and a few forgings. The machine primarily consists of two 12-in. brake cylinders which operate a series of levers. The horizontal cylinder performs two functions; first, it operates the V-shaped arm at the right, the purpose of which is to do away with the old clamp and screw method of bringing the spring leaves together prior to applying the band; second, it compresses one side of the spring band. When the spring with the heated band is properly blocked in position, the horizontal plunger is first applied and held under pressure, while the vertical plunger is applied.

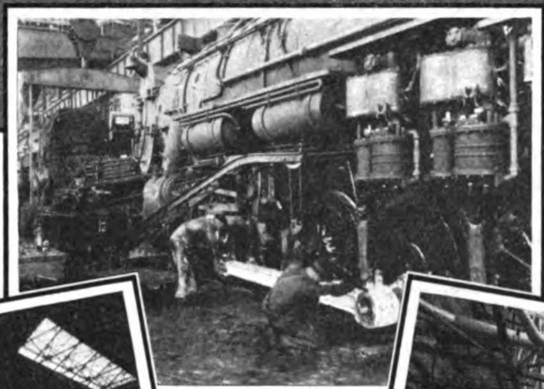


Spring banding machine built of scrap material, which has increased production 40 per cent

The leverage on the fulcrum arm is five to one. A safety yoke on both fulcrum arms prevents the piston from making the full stroke and thus applying pressure on the top head of the brake cylinders which is undesirable. All the pins and rollers are case hardened. The operating pressure is 75 lb.



Stock car built for the National Railways of Mexico by the Pressed Steel Car Company



New and Improved Machine Tools and Shop Equipment

Pratt & Whitney model B 20-in. lathe

A NEW lathe has just been added added to the line of Model B lathes manufactured by the Pratt & Whitney Company, Hartford, Conn.—a division of the Niles-Bement-Pond Company, New York. This new lathe is somewhat similar to the 13 and 16-in. sizes, but the increased swing with the necessary extra power and strength has resulted in several interesting departures from the standard Model B design.

The large model is designed primarily for motor drive and uses the same general scheme of mounting the motor as the other machines. By placing the motor in a cabinet leg beneath the headstock, it is not only out of the way, but is so far below the center of gravity that vibration from this source is practically eliminated. The result is a quiet, solid machine, with plenty of power to carry the heavy cuts which this size of lathe is often called on to take.

A 7½ hp. motor is the regular equipment recommended for the machine and is regularly installed equipped with push button control, low voltage protection and full electrical equipment. The drive may also be by means of a constant speed single pulley belted to a lineshaft.

The drive is carried by a belt to the main drive shaft located at the rear of the machine and is thence carried to the headstock and feed mechanism through gearing. A friction clutch operated by a shoulder high control rod running the length of the bed controls the power coming into the machine. This control rod forms a convenient device for throwing the power on and off without stopping the motor. The clutch is a standard No. 6 Johnson friction clutch running in oil.

The new 20-in. lathe has 16 spindle speeds instead of the usual eight. A lathe of this size is frequently used in toolrooms to swing large jig work in which both small and large holes are to be bored. To do such work efficiently, the greater speed range is needed.

The geared head is of the same general design as the 16-in. Model B lathe. The speed changes are handled by the same convenient speed change levers from the front of the headstock, except that there is an extra lever which shifts a high and low range speed change on the main drive shaft. A range of 16 spindle speeds is provided, from 6 to 383 r.p.m. The back gears are situated beneath the spindle nose which gives them a vertical motion for engaging and disengaging. This location completely does away with overhanging parts, and the result is a compact and symmetrical headstock which does not in any way hinder the maximum amount of light from reaching the work centers.

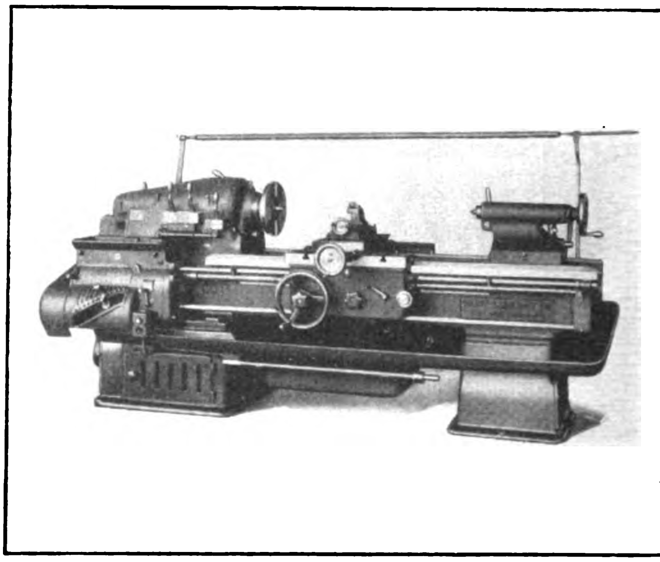
The back gear lock takes the form of a gear clutch. This is simply a pair of spur gears which slide back and forth inside of two internal gears so that when the spur gears are shifted to the left, the back gears may be engaged and when shifted to the right a positive connection is formed between the spindle nose and the spindle speed change gears. Thus it is possible to throw in the back gears and operate the lock by merely moving the spindle through a distance corresponding to the width of one tooth instead of feeling for the hole with the spindle locking pin, as was the case with older types of lathes.

The oiling of the headstock is particularly noteworthy. The lower gears of the headstock train dip into a reservoir of oil and splash-oil the others. In addition to this, there is a geared pump which sends oil up to a spreader. This spreader sprays the oil over the top of the entire gear train.

The hole through the spindle is 2 in. in diameter and the taper hole in the spindle nose is ground to a No. 19 Jarno taper. The spindle nose has both flat and tapered seats in addition to the threaded portion so that an accurate face plate seating is always assured.

Leading down from the spindle, a train of gears carries the power to the feed gear box which is situated at the front of the machine. This gear box is designed so that a rocker lever and a ratio lever work in unison with a direct reading index plate, and any desired feed or thread per inch may be instantly set by placing these two levers in the correct relation to the one plate. Thus there is no reading of charts with their chances for error. The range of 36 threads is from 1 to 56 pitch, while the feeds range from .0030 in. to .1667 in. for both carriage and cross feeds. By combining the two power feeds, a 45-deg. taper may be cut.

Both a lead screw and a feed rod are provided. A small gear shifting device is so arranged that when the feed rod is being used, the lead screw is idle and vice versa. In addition to the lead screw and feed rod, a stop and reverse rod runs the length of the bed. It is so placed that it will protect the lead screw from damage from falling tools or work. This rod forms a convenient method of controlling the feed of the tool.



The model B20-in. lathe is available in three bed lengths with 48-in., 72-in., and 96-in. center distances, respectively

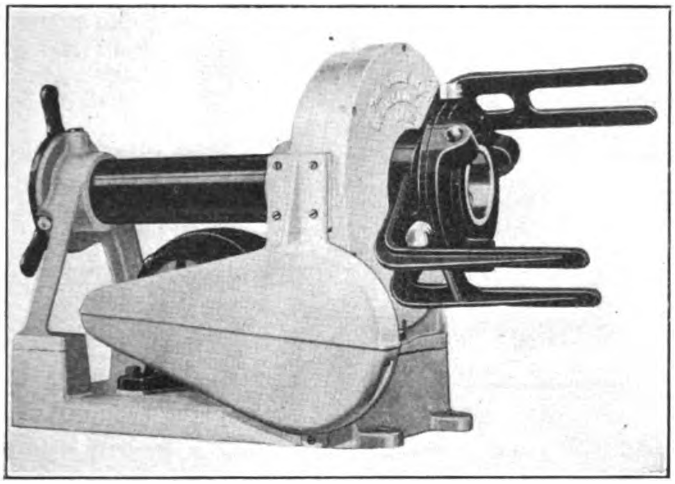
The quick withdrawing device has been incorporated in the 20-in. lathe, which consists of coarse and fine threaded screws so arranged that either one may be engaged as desired by the simple tightening of one or two bolts. When engaged, the quick withdrawing device allows the tool to be completely withdrawn from the coarsest thread by a quarter of a turn of the cross feed hand wheel. In addition to this device stop and threaded nuts are provided.

The hand wheel of the compound rest is mounted at an angle to afford knuckle clearance, and to enable the micrometer dial to be more easily read.

The machine is available with three lengths of bed, with 48-in., 72-in. and 96-in. center distances, respectively. The net weight of the 48-in. machine with regular equipment is approximately 6,200 lb. without motor or electrical equipment. Additional equipment includes a taper attachment, oil pan, collets, chucks, etc.

Portable power pipe threader

THE Oster Manufacturing Company, 2057 E. 61st place, Cleveland, Ohio, has recently introduced a new and lighter weight model of its power drive for pipe tools. The body of the machine is made almost entirely of an aluminum alloy which is not only stronger and more durable than the former cast iron model but is much lighter in weight. The new machine weighs only 150 lb. and is portable without removing any parts.



Oster Power Boy pipe threading and fitting machine

The driving power is furnished by a ½-hp. universal, reversible motor which automatically speeds up on the smaller sizes of pipe and holds the necessary speed on the larger sizes, giving the outfit a greater production capacity. The universal motor can be run from any 110 or 115-volt lighting circuit either direct current or alternating current, single phase and of any frequency from 25 to 60 cycles. Its reversible feature makes it possible to use nearly any die stock in connection with the machine.

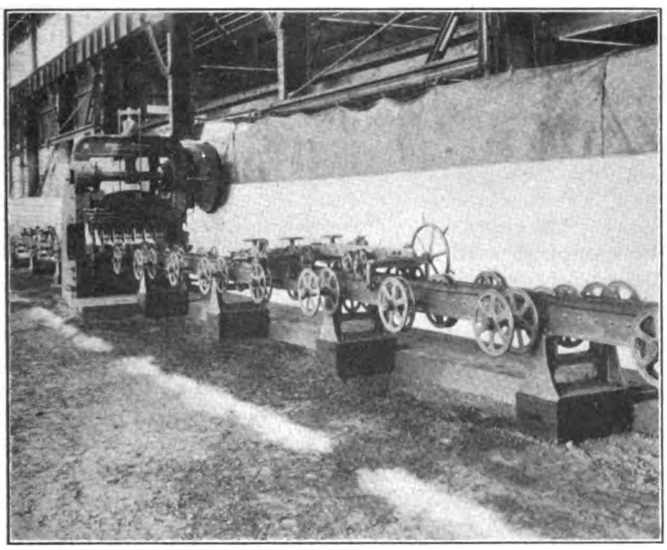
The machine itself will drive die stocks and pipe cutters up to 2 in. capacity but with a special auxiliary drive shaft geared die stocks and cutters up to 6 in. capacity can be driven. In addition to this the machine can be used to screw up fittings, as a pipe wrench can be held in its driving arms and revolved.

The pipe is held stationary in a three-jaw self-centering chuck and the pipe tools are turned by the driving arms. Self-centering universal guides in the rear of the machine assist the front chuck in centering long pieces of pipe.

An idea of the compactness of the machine can be gained from the fact that it is only 18⅛ in. high, 14½ in. wide and 30 1/6 in. long.

Spacing table for punching machines

IMPROVED and simplified features are embodied in the hand operated spacing table recently placed on the market by the Stiening Spacing Machine Company, 1016 Empire Building, Pittsburgh, Pa. The machine, as illustrated, is of the triple pass type, used in connection with a large multiple punch and arranged to handle plates, angles, beams, columns and other structural shapes for web punching. One pass of the table may be arranged with adjustable rollers thereby allowing the table to be used both for web and flange punching. As there is no direct connection between the table and punch, this table can be used with a punch already installed.



Hand operated spacing table for punching plates, angles, etc.

The template on this machine is of the permanent type, made of high carbon steel and arranged to accommodate hardened steel pins. The set-up is accomplished by inserting the template pins at the required spaces. This arrangement makes possible a very quick set-up and eliminates the necessity of making a separate template for each particular job. This allows the machine to be effectively used even when only a few duplicate pieces are to be punched. The template arrangement is such that fractional spacings of sixteenths may be obtained.

The material after being loaded on the trailer table is gripped by means of quick acting gripper carried on the spacing carriage. The arrangement of this gripping device allows holes to be punched close to the end of the material. The trailer carriage is equipped with a lever operated gripper which releases near the end of the spacing and is only used when punching plates. Other materials are gaged at the punch and need not be held by a trailer gripper. A centering device is provided which quickly centers the plates before they are gripped.

The spacing carriage which feeds the material, is manually controlled by the operator, who propels it by means of a large handwheel. The travel of the carriage is arrested against the template pins, thus assuring positive, accurate spacing. After the punching operation the operator disengages the template dog by means of lever located near the handwheel and then feeds the material until the dog engages the next template pin. The spacing carriage is equipped with a multiple number of template dogs which allow for an entirely different series of set-ups to be made on the template at the same time. This feature makes possible the complete punching of an angle, having different spacing of the holes in the two legs, without removing the angle from the table or without resetting the template. In this manner the necessary handling of the material is reduced to a minimum.

Improved locomotive tire boring mill

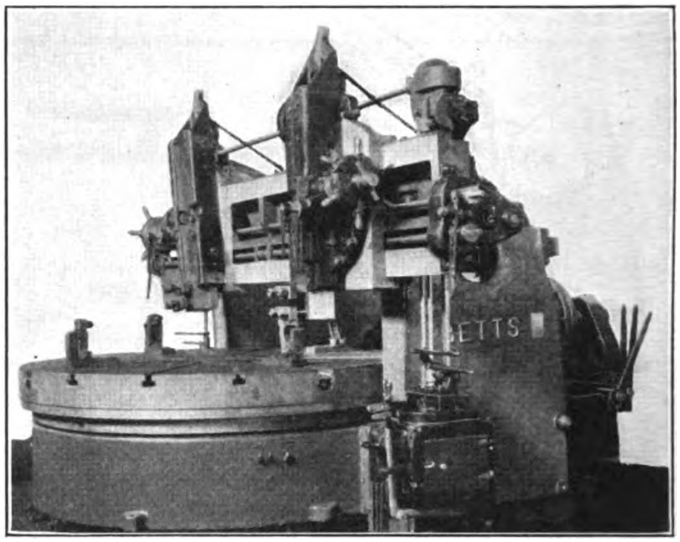
AN improved design of vertical tire mill for boring and turning steel locomotive tires has recently been developed by the Betts Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. The illustration shows a 90-in. machine which has a swing of 100 in. Machines of similar design have been built in 66-in., 72-in., 84-in., 96-in. and 108-in. sizes.

Compared with Betts tire mills of earlier design, it will be noted that this machine has a narrow guide crossrail, power rapid traverse to the saddles and the tool spindles driven by independent motors. It has a continuous feed with eight changes through sliding gears and speed change gears fully enclosed and running in oil. The speed change gear box is built into the bed at the rear of the machine between the uprights.

The table is equipped with a four-jaw universal chuck for centering the tires. The application of a wrench at any one of the jaws causes all the jaws to move inward, thereby automatically centering the work. Each jaw is provided with a special eccentric hold-down clamp for use when boring. The clamps are tilted backward readily to permit the removal of the tire. Special heavy-duty clamps are used in connection with the universal chuck for withstanding the thrust of the form tools in turning the treads.

This machine is designed for heavy duty. All the driving and feed gears, as well as the saddles and tool spindles are made of steel. The tool spindles are of extra heavy rectangular section and are carried in swivels provided with square guides throughout.

The crossrail has a wide face and no vertical adjustment. Machines of similar design are built with a movable crossrail for shops requiring more room under the tools. The feed and power rapid traverse may be engaged, disengaged and the direction reversed by means of two levers located conveniently just above each feed box.

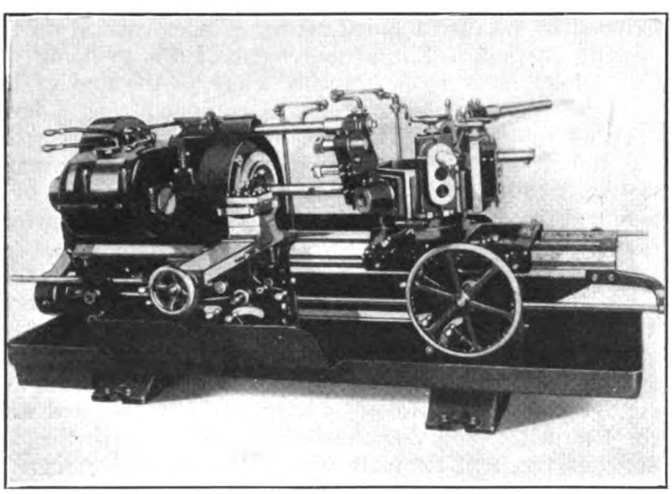


Betts 96-in. tire boring mill which has a swing of 100 in.

The table is of unusual depth and is driven by steel internal gears of large diameter, wide face and coarse pitch. Alemite lubrication is used for the main bearings.

Protected ways a feature of new turret lathe

AN enlarged No. 3-A turret lathe has recently been announced by the Warner & Swasey Company, 5701 Carnegie avenue, Cleveland, Ohio, in which greater driving power and rigidity have been embodied.



Complete tool equipment is provided for bar and chuck work—The machine is shown here tooled for chucking operations

This machine also incorporates an improvement in turret lathe design which is of more than usual interest—a method for protecting the ways from grit, chips or cutting lubricant. In this way the alinement of a recently purchased machine, an indispensable feature for accurate work, is maintained in harmony with the performance of other machine members. All the advantages of the present 3-A turret lathe are retained and the design permits the taking of cuts from the hexagon turret and the square turret at the same time. In addition, the tooling provides for multiple cuts from each turret station, and the proper rigidity for supporting such cuts with heavy feeds. The new 3-A machine is universal for either bar or chucking work. On chucking operations the machine will regularly be equipped with a 22-in. chuck. The maximum swing over way covers is 25¼ in., and the square turret carriage clears a diameter of 18 in. The hexagon turret carriage has a maximum longitudinal travel of 48 in., while the square turret has a cross travel of 12¾ in. For bar work the machine has a capacity through the chuck for 7½-in. round bars, with a maximum turning length of 39 in.

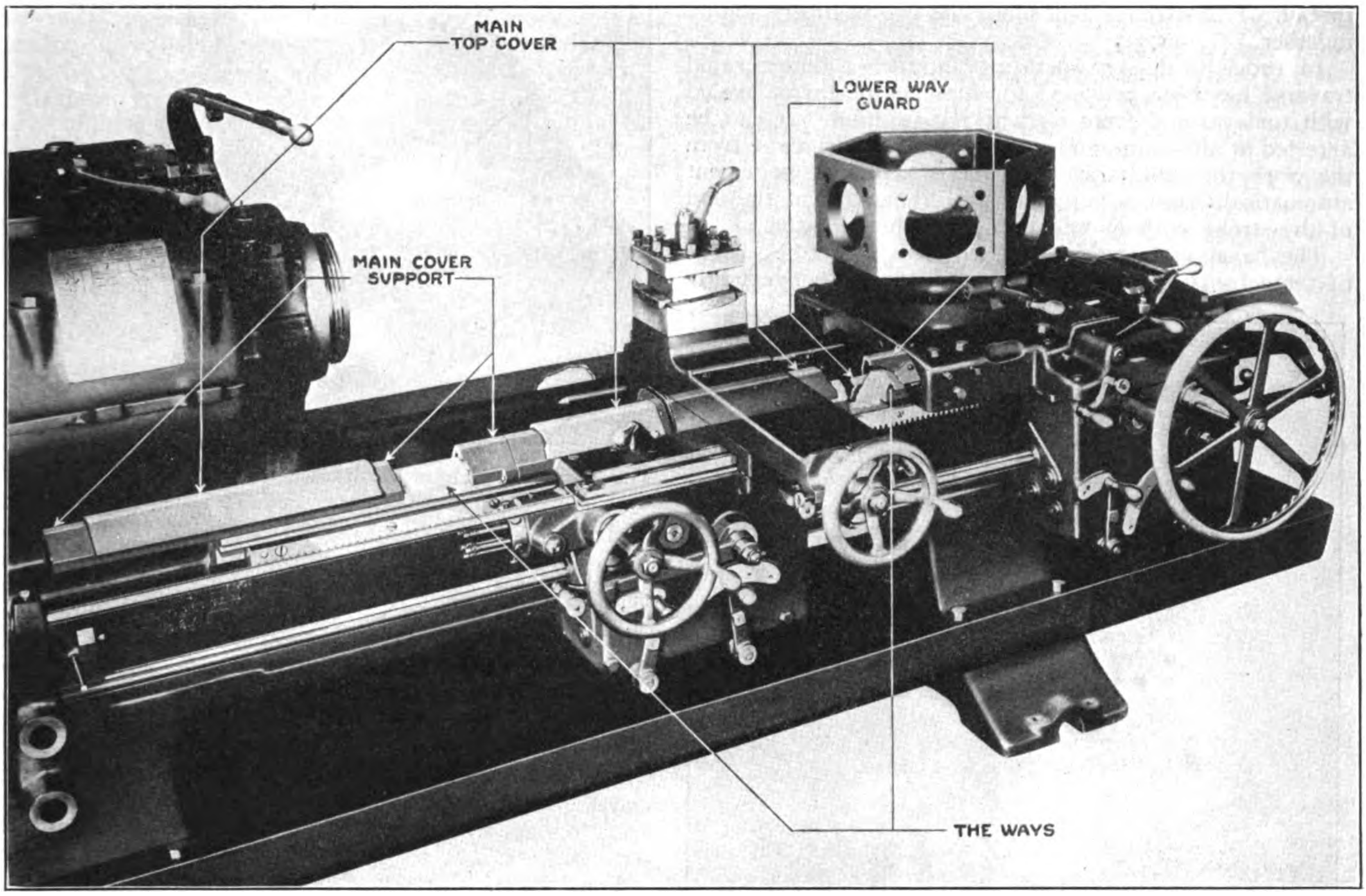
The new patented way covers completely enclose the ways of the bed. All of the ways of the machine are covered, regardless of the simultaneous operation of the hexagon turret and the square turret in different positions along the bed. Grit, chips and cutting lubricant are prevented from reaching the surface of the ways, and wear from the continual dropping of chuck wrenches or tools is avoided. The construction of the way covers is shown in one of the illustrations. The pressed steel main top cover runs the entire length of the ways, passing through an inverted vee slot in the square turret carriage. The main top cover is fastened to the hexagon turret saddle, thus moving independently of the square turret carriage. The left, or

free end, of the main top cover, is supported by the main cover support, a heavy cast iron member attached to the square turret carriage and moving with it. This support provides solid metal between the main top cover and the ways, so that heavy chucks may be mounted or heavy work gripped without damaging the way covers. In order to prevent any chips from working up underneath the main top cover in the space between the hexagon turret saddle and the side carriage, a lower way guard is provided. This guard is attached to the right side of the square turret carriage, moving with it, and passing into a slot in the hexagon turret saddle. The rear way at the back of the machine is protected by a heavy rolled cover which rests directly on the ways and passes through a tunnel at the back of the all geared head. Two shorter covers are also added at the back of the hexagon turret saddle to prevent chips from dropping off the tools onto the rear ways. To provide a reliable method of lubrication when the ways are enclosed, the square turret is fitted with an oil plunger pump which can be easily filled from an ordinary oil can. Oil is thus fed by pressure onto the ways of the machine. Oil is also provided for lubricating the hexagon turret ways.

The head of the machine is cast in one piece with the bed which is typical of other Warner & Swasey machines. The all-geared head is designed to produce ample power through a series of broad-faced, hardened and heat-treated alloy steel gears. These run in oil, and can absorb a maximum in-put of 25 hp., although a 10, 15 or 20-hp. motor may be used for the average range of light to heavy work. While flood lubricant is provided for the entire head, the main spindle bearings are constantly supplied with clean oil from oil cups. Twelve spindle speeds, both forward and reverse, are instantly available.

Another new feature is that the front and back shafts and also the drive shaft run in taper roller bearings with adjustment for end play. This construction makes possible a narrower arrangement of the head in the front and rear, so that the cap bolts of both spindle bearings are readily accessible. The use of taper roller bearings also increases the power efficiency, so that a greater proportion of the total power in-put of the machine can be used for actual cutting purposes.

The spindle is machined from a solid hammered billet by drilling out the core, in accordance with the established Warner & Swasey custom. The material is a hard, wear, resisting steel and the spindle is ground on all outside diameters over the bar into gear diameters. The spindle nose is of an entirely new type. It is threaded for fastening the chuck securely onto the spindle, but the pilot is tapered instead of straight. This gives a taper bearing for alinement for mounting chucks or fixtures, and is extremely rigid. In case of wear, it is possible to dress up the taper and the front shoulder to a new and accurate fit at any time throughout the life of the machine.



Phantom view of the way covers on the Warner & Swasey enlarged 3-A turret lathe

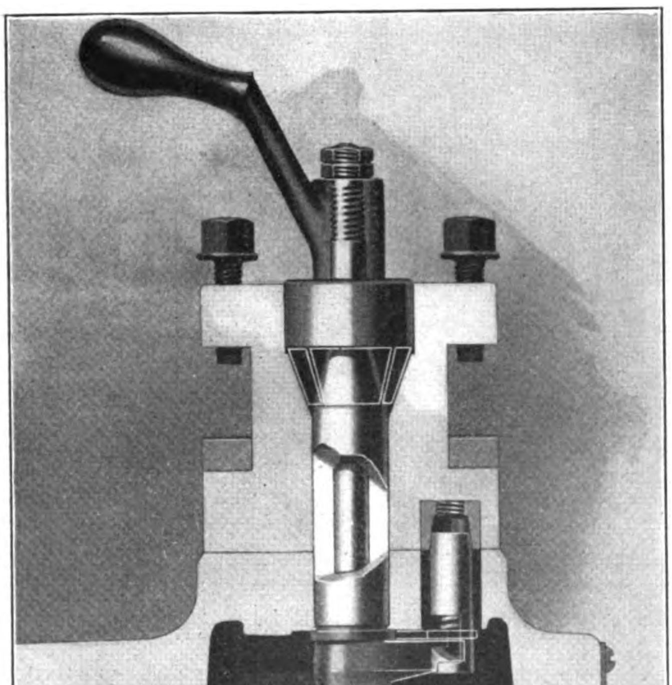
Because of the power developed in the head of the machine and the necessity for absorbing the maximum torque, the head, is cast solid with the bed. The square turret carriage is anchored to a third rail or guide at the lower front of the bed. Thus the cross slide does not have to reach across the ways for rigid anchoring, and the spindle, the hexagon turret, and the square turret can all be brought close to the bed without sacrificing the maximum swing over the square turret carriage. This design also permits the square turret to be run out of the way to the extreme left and past the chuck when chuck and work are less than 18 in. in diameter.

The turret is of the heavy hollow hexagon type with

broad faces to which the tools and holders are bolted from the inside. Aside from the structural strength of this box type of turret, assurance of the accurate alinement for center piloted or overhead piloted bars and other tools is given by means of projecting bosses which enter large holes in the turret faces. The turret is mounted on a heavy saddle which has its bearing directly on the ways of the bed. A vertical lock bolt, located immediately under the working tool, locks the turret accurately in any of its six positions. The center pivot stud is tapered and cast solid with the turret. It fits into an adjustable tapered bushing in the saddle so that accurate alinement can always be maintained. To provide accurate alinement for heavy duty work, the turret is clamped to its seat by an outside split ring binding mechanism, which is a patented feature. This ring has a double taper which hugs the tapers on the saddle and turret respectively. A single lever is employed for operating the ring through a right and left hand thread. This arrangement binds the two members solidly together.

In order to lessen operating fatigue, a power rapid traverse has been provided for moving the turret loaded with tools to and from its working position. It can be arrested at any point, and on the return stroke away from the work the rapid traverse lever is kept in engagement automatically and is automatically disengaged at the end of the stroke without attention from the operator.

The hexagon turret is equipped with 16 feeds. Eight of these feeds are readily obtained by levers conveniently



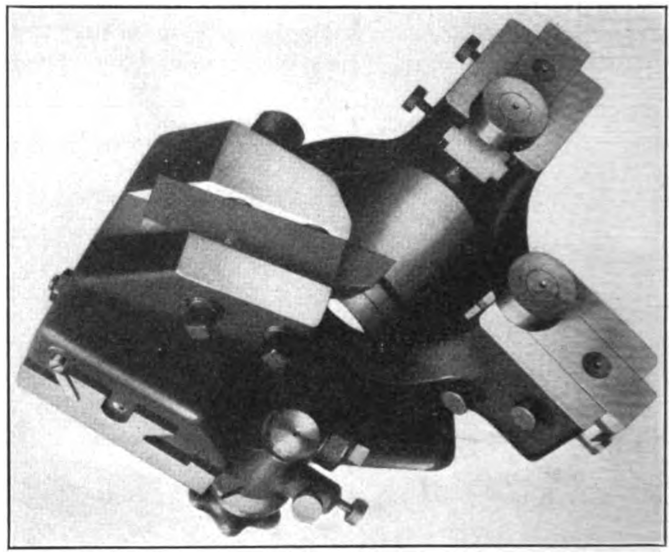
The square turret may be clamped in any position by a quarter turn of the binder handle

located in the turret apron itself. An additional lever operates a doubling gear located in the gear box at the head end of the machine, thereby making available a selection of 16 feeds from .005 in. to .167 in. per revolution of the spindle, for any kind of work which comes within the range of the machine.

The turret feed is engaged and may be reversed by levers also contained in the saddle apron. The feeds are automatically and accurately disengaged by adjustable stops on the roll. This is located between the V's. The stops can be quickly and accurately set, an important feature for small lot work.

The square turret, which is mounted on the carriage, will hold four or more forged tools. The turret is indexed without being lifted from its seat, and can be clamped in any position by a quarter turn of the binder handle. The narrow construction of the turret allows the hexagon turret to come close to the work without danger of interference, and thus turning cuts, even in close quarters, can be taken by the hexagon turret, leaving the square turret free for the facing cuts. This permits a wide application of the principle of combined cuts.

The new arrangement for feeds provides 16 longitudinal and 16 cross feeds for the carriage. These may be operated either forward or reverse. With the wide



The universal turners are provided with large dials having graduations for accurate sizing

range of feeds, peripheral turning, cross facing or recessing operations may be performed by the square turret tools while the hexagon turret is engaged in drilling, boring or turning cuts. The longitudinal feed to the carriage may be accurately and automatically disengaged by six adjustable stop screws which are mounted on a revolving spool in the apron. To assist the operator in cross feeding, a large dial is mounted on the screw near the handwheel for accurately gaging the depth of the cut. This dial is graduated in thousandths, and numbered metal clips are provided for securing accurate repetition of the settings.

For bar work this machine is fitted with a three-jaw chuck, ratchet bar feed with work support, two universal turners, pointing or chamfering tool, tool holders and a three-in. automatic die head.

The equipment for the new 3-A is so designed that full advantage may be taken of the principles of combined cuts, multiple cuts and rigid tooling. Overhead piloting is regularly provided. The overhead pilot set of chucking equipment consists of a three-jaw, extra heavy chuck, a multiple turning head, two slide tools, one short and one long flanged tool holder, one multiple turning head, two center pilot boring bars with boring heads, and two center pilot bars and spindle bushing.

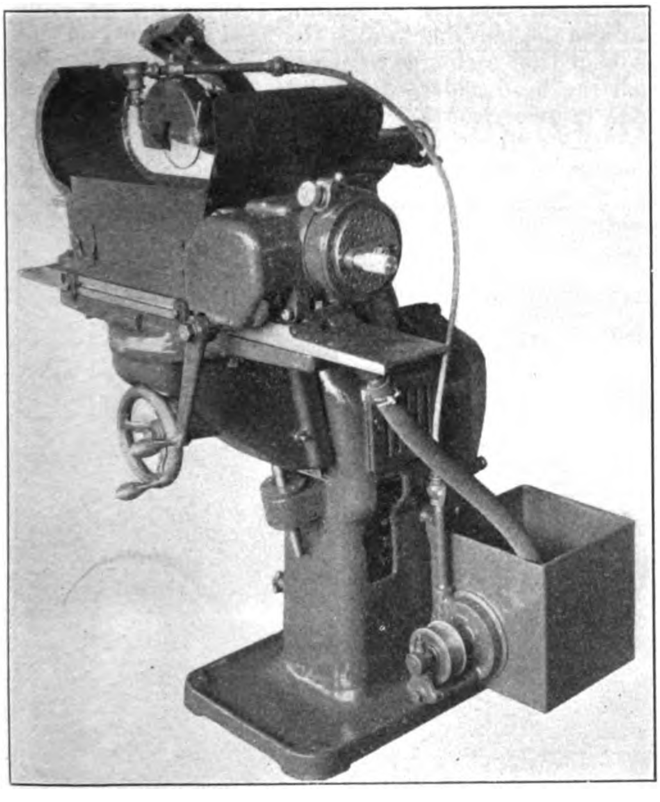
A taper attachment may be mounted on the base located at the front of the carriage beneath the cross slide. The attachment consists of a slide with an adjustable swivel plate which guides a hardened and ground block pivoted directly under the nut of the cross slide screw. The attachment may be readily withdrawn when not in use. Tapers 12 in. long can be turned up to 1½ in. per foot

(an angle of 3 deg. 35 min. with the center-line, or 7 deg. 10 min. included angle). By means of a special plate, tapers 6 in. long can be turned up to 3 in. per foot (an angle of 7 deg. 8 min. with the center line, or 14 deg. 15 min. included angle). Either type of taper attachment may be used.

Hob and cutter grinder for the tool room

The Pratt & Whitney Company, Hartford, Conn., division of Niles-Bement-Pond Company, New York, has recently introduced a new hob and cutter grinder, which is designed for general use in sharpening gear hobs, thread hobs, form milling cutters, Pratt & Whitney "curvex" cutters, and for sharpening any cutter which must be ground in the flutes.

The grinder is motor driven with the motor mounted inside the column on a hinged platform. A belt drives a pulley on the wheel spindle which provides a smooth drive necessary for grinding. The hinged platform, on which the motor is mounted, has a screw adjustment for regulating the tension of the belt. A 3/4-hp. motor with a 1 1/4-in. belt is sufficient for ordinary sizes of cutters, but in cases where it is necessary to sharpen the cutters of large diameters having deep gashes, a 1-hp. motor with a 2-in. belt is recommended. Mounting the motor in this manner has several advantages, in that it is kept free from dust and dirt but at the same time is well ventilated. It is set low enough to avoid vibration.



Grinder designed for general use in sharpening gear hobs, thread hobs, form milling cutters, etc.

The column of this machine is a single casting which provides a rigid construction. It carries the knee on a dovetail slide at the front, the top surface of which is machined for mounting the wheel slide. The wheel head is mounted on the top of the column casting, as shown in the illustration. A hand wheel for traversing the grinding wheel is located on the rear of the slide, conveniently for the operator. A graduated dial on this hand wheel permits accurate setting. The grinding wheel spindle is mounted on ball bearings and provision is made for adjustment of end thrust. All bearings are protected by felt washers to prevent possible injury from grinding dust. The grinding wheel is trued to an angle which enables it to clear itself when it is used for grinding in a spiral fluted cutter.

The face of the knee slide is at an angle of 12 deg. from the vertical in order to correspond with the cone angle of the grinding wheel. Elevation of the knee is controlled by an elevating screw operated by a large hand wheel located in front of the machine. This hand wheel is connected to the elevating mechanism through a pair of bevel gears. A binder is provided for holding the knee in position.

The table is arranged to pivot on the top of the knee so that it may be swung to any angle with the wheel spindle, in order to compensate for the helix angle of the cutter being ground. A rack and pinion driven by a hand lever is used to traverse the table longitudinally. Stops are provided to control the table movement. The tailstock is mounted in a tee slide in the table so that it may be adjusted for various lengths of cutters. The tailstock spindle is of heavy construction and is held in position by a binder.

The same pinion which meshes with the table rack also meshes with the gearing within the index head, which produces the necessary rotary motion when grinding spiral flutes. A system of change gears provides for all leads varying from 3 in. to 133 1/3 in. Movement is taken from the change gears to the spindle through a pair of bevel gears. On the rear of the spindle is a large helical spring to eliminate back lash in the mechanism.

Turning a small knob on the top of the index head rotates the head spindle through a small arc sufficient to pick up a flute with the grinding wheel. A lock pin is placed on the rear of the index head by means of which the spindle may be locked in position when it is desired to grind straight flutes. When grinding straight flutes, it is necessary to take out the change gears so that there is no connection between the index head spindle and the table driving rack. The nose of the spindle is equipped with a suitable driving dog. Indexing is accomplished by index plates, shown in the illustration, on the rear of the indexing heads. The plates are of the type that is provided with holes, similar to those generally used on a universal milling machine.

This machine is equipped with a truing device, which is shown in the illustration, pivoted on the side of the column. It is mounted on a swinging bracket which can be swung back out of the way while the grinding wheel is being used. When it is desired to true the wheel, the wheel guard is raised and the truing device is lowered into position where it is held in exact location by a pin. A regular truing diamond bar is used and pins on the truing slide provide locating points for obtaining the exact angle on the wheel. The truing slide may be rotated through a short arc to obtain an exact setting by means of a setting gage which is provided with the machine.

Ordinarily this machine is used as a dry grinder. It may be arranged, however, for wet grinding by adding a water tank to the side of the column and equipping the

machine with a pump which can be driven by the same motor that drives the grinding wheel. Suitable water guards for the table are available together with the necessary troughs for returning the water to the tank. This grinder occupies a floor space of 58 in. by 40 in. and is 51 in. high.

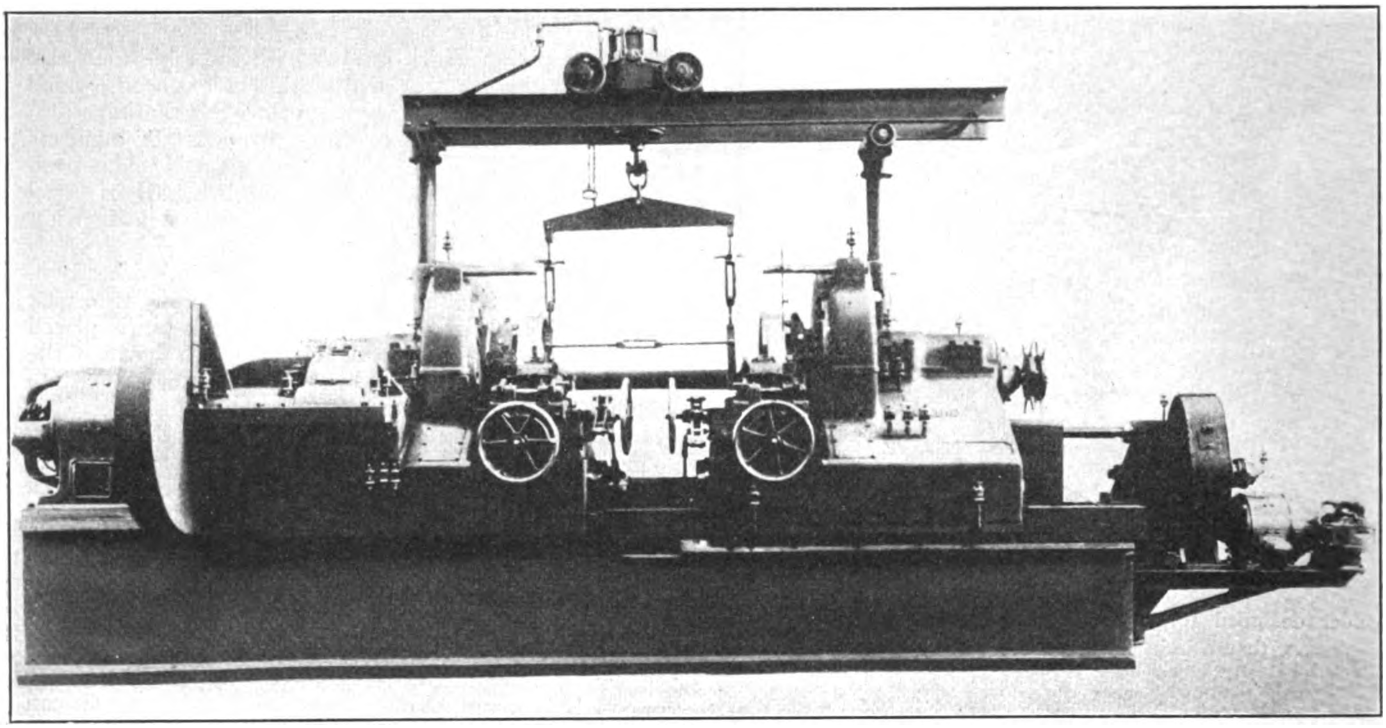
Gasket and joint cement and rust solvent

It is often necessary when repairing machine tool equipment to make gaskets tight or stop oil leaks in a lubricating system. Plasgon plastic gasket and joint cement, manufactured by the Polygon Products Company, 141 Milk street, Boston, Mass., is used for the above purpose. It is oil, acid and water proof, sets quickly and solidly and does not crack or disintegrate. It is squeezed out of the tube in which it comes and is spread on with a small wood paddle to form any shape of gasket required. It can also be used for making tight joints on pipes, handhole plates, valve bonnets, leaky flanges, bolts, studs, etc.

Another product of this company is Tasgon, a rust solvent, which is used for loosening up tight joints or connections. A few drops of Tasgon on a rusty nut, bolt or threaded joint are said to dissolve the corrosion and help make the disconnection easy. It is said not to injure metal.

Wheel turning lathe for car wheels

The car wheel lathe shown in the accompanying illustration is essentially the same in general design and proportions as those machines previously built by William Sellers & Co., Inc., 1600 Hamilton street, Philadelphia, Pa. Improvements have been made, however, to simplify the manipulation so that the least possible time and labor should be required for handling and settling the work and for bringing the necessary tools into successive operation; to take the heaviest cuts with the highest speeds that new tool steel will permit; to turn all kinds of steel car wheels, or car wheels with steel tires from 28 in. to 42 in. in diameter, whether they be of plate, arm, or composite construction, without requiring any holes or openings in the wheels for bolts or drivers; to provide for axles with inside, as well as outside journals, and to accommodate axles with driving gears or armatures between the wheels.



Sellers 42-in. car wheel lathe

The method of supporting the movable head on the bed is novel. There is no bearing between the top of the shear and the movable head. The head is carried on steel bars bolted on each side of the bed, forming tracks upon which the head slides. The slide bearings on the head consist of two removable shoes which rest on these bars. Taper shoes are provided between the head shoes and the underside of the overhanging lathe shear, which may be adjusted to eliminate excessive lost motion between the bed and the head. This arrangement protects the bearing surfaces from chips and dirt by the overhang of the top shear, and it has the additional advantage that all parts which may become worn in heavy service can be removed and replaned without dismantling the lathe.

The gearing from the motor to the faceplates is heavy. Two sets of herringbone gears are included in the train, which help to give smooth action and a good finish to the

wheels. All bearings are bronze bushed and all pinions except the motor pinion are supported with bearings on both sides.

The right-hand head is adjusted by a motor mounted at the extreme right-hand end of the machine. The motor drives a screw through a slip clutch, which protects the gearing and limits the initial pressure applied to the drivers. A solenoid brake, which holds the mechanism whenever the power is turned off the motor, serves to clamp the head securely in position. This automatic clamping eliminates one detail which the operator of the machine or his helper usually has to take care of. He is thus relieved of work and of the danger of forgetting to clamp the head, with its attendant possibility of damage to the machine.

Each faceplate is provided with three self-tightening drivers. Each consists of a stand bolted to the faceplate, with bolts sliding in slots. They are thus adjustable for wheels of various sizes. The driving arm has trunnions carried in this stand, and is provided with a serrated bit and cam, both of hardened tool steel. The function of the bit is to grip the wheel to turn it. In case the wheel starts to slip, the cam at the other end of the driver will move in such a way that it will force out the long end of the driving arm from the wheel, thus putting more pressure on the bit. In this manner the pressure of the cut will tighten the drivers and automatically prevent any further slipping.

The drivers are brought in contact with the wheel when the movable head is slid into place, and as all the drivers bear equally upon the wheel the tendency to distort the wheels or axle is entirely eliminated. The tool posts are each an integral part of their respective heads, thus the tool maintains a fixed relation to the faceplate irrespective of the gage of the wheels being turned, and a considerable amount of adjustment is eliminated.

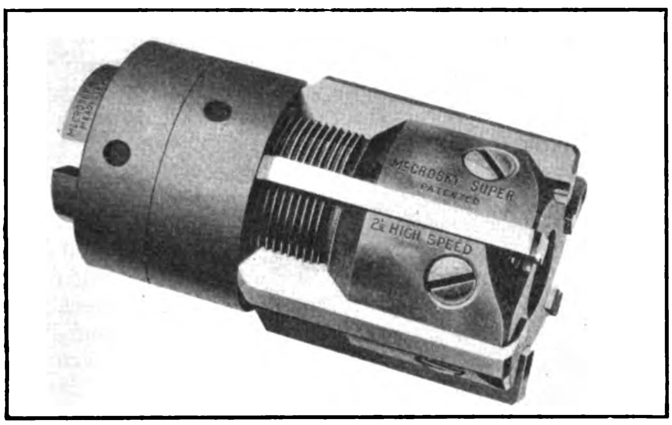
The turret is made of vanadium steel and so designed as to require the least possible projection of the tools. Should the roughing tool require changing during an operation, it may be removed from the back of the turret and replaced without stopping the lathe or without revolving the turret.

The slides are provided with heavy steel shoes, hardened and ground on the surfaces that are exposed to dirt and chips. Adjustments for wear are provided.

Four tools for each turret are required for the entire operation of turning a wheel. These are arranged in the order of their use, one on each side of the turret. A partial turn of the wrench is sufficient to tighten or release the turret, which may readily be turned when free. When the proper tool is opposite the work, a double cam stop is laid over behind the turret, rigidly clamping it.

An adjustable reamer and a lathe turret

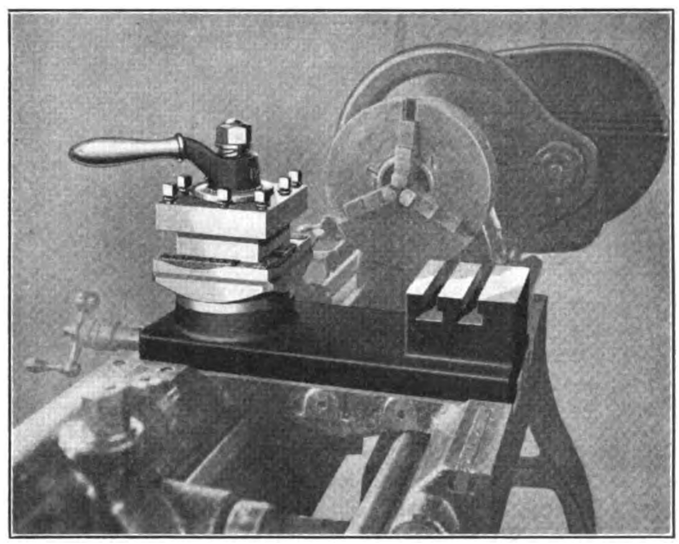
AMONG the new tools which have recently been added to those manufactured by the McCrosky Tool Company, Meadville, Pa., are an adjustable reamer and a turret for use on engine lathes. One of the features of the reamer, known as the McCrosky Super reamer is



The blades of this reamer may be reground from 10 to 20 times

the method of locking the adjustable blades. A key, made of drill rod, holds each blade in its slot and the key in turn is gripped by a hardened steel headless set-screw. In order to provide clearance and support, the reamer body has been relieved in front of the cutting edge of each blade to provide ample space for chip clearance and lubrication. In addition to minimizing the possibility of chips clogging along the cutting edge of the blades this clearance makes it possible to shorten the projection of the blades over the end of the reamer body. Adjustment of the blade is made forward to increase the diameter in such a manner that the bottoming feature is continually maintained and the cutting end of the blades is always slightly in advance of the reamer body. Sufficient stock has been left so that by radial regrinding a total adjustment range of .125 in. is secured which makes possible from 10 to 20 regrindings for each set of blades. Only six sizes of blades are required to fit all sizes of these shell and chucking reamers from 15/16 in. to 14 in. diameter.

The turret for engine lathes provides a means for materially increasing the range of work which it is possible to perform on an engine lathe. These turrets are made in nine sizes of square, round and hexagon types; the square turret being shown in the illustration. The



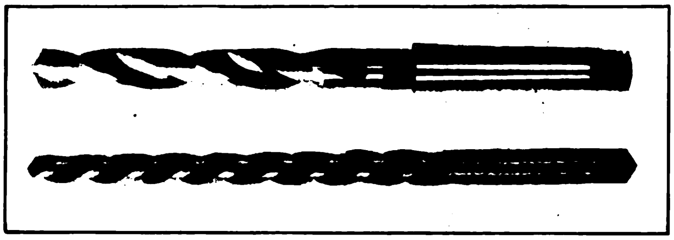
McCrosky square turret mounted on special cross slide for multiple tool set-ups

indexing feature consists of the revolving body which has a corrugated bearing surface on its under side which meshes into similar corrugations on the stationary base. Releasing the clamping handle a half turn raises the turret body clear of these corrugations, permitting the turret

to be swung to any of the 12 indexing positions. Thus a three-tool turret has four positions available for each tool desired; a four-tool turret, three positions and a six-tool turret, two positions. The illustration shows a square type turret mounted on a special cross slide for multiple tool set-ups.

Forged type drill and taper pin reamer

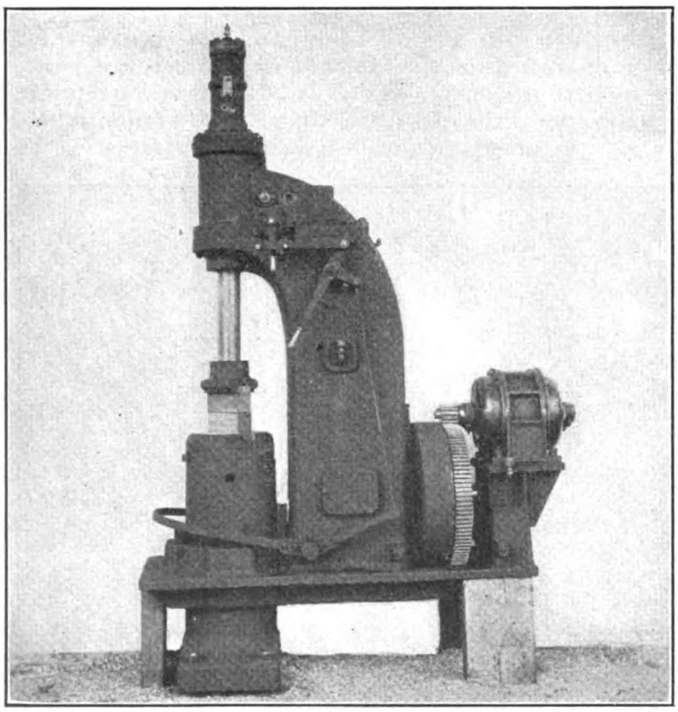
REALIZING the demand for a rugged, sturdy drill of the forged type, the Morse Twist Drill & Machine Company, New Bedford, Mass., has developed a forged type drill of the type shown in the illustration. These drills are furnished in sizes ranging from 5/16 in. to 2 in. This company has also added to its line of drills and reamers a three-flute taper pin reamer. This reamer was submitted to the Tinius Olsen Testing Machine Company, Philadelphia, Pa., for comparative tests with reamers of the three-flute left-hand spiral and straight flute types. These tests were made at the same time in machine steel 1½ in. long, feeding the reamers through 2½-in. penetration. The results of these tests showed that the three-flute left-hand spiral reamer broke under a force of 5½ in.-lb., the straight flute reamer broke at 34 in.-lb., and the three-flute right-hand spiral reamer, broke at 55 in.-lb. The design of the new taper pin reamer provides for free cutting action and clears itself readily of chips, which makes it especially adaptable for production work.



Top—Morse high speed forged type drill; Bottom—Tapper pin reamer

Bates air-operated hammer

THE Bates air-operated hammer built by Williams, White & Company, Moline, Ill., is featured by instant response to the treadle. Light, medium or hard blows are obtainable at will and with consistent regularity. The operator can stand close to the anvil and there is an unobstructed view of the work as well as of the ram and dies, so that the hammer can be manipulated with the greatest precision.



Bates air operated hammer

When the treadle is released, the ram lifts to the upper end of the stroke and is held suspended so long as the compressor continues running in the idling position. The downward stroke of the ram is produced by the compressed air injected into the upper end of the ram cylinder. The force of the blow is augmented by the vacuum created underneath the ram piston, as well as by the compression produced in the top of the compression chamber by the previous upward stroke of the ram. A relief valve is also provided with a hand lever by which the compressor may be opened instantly in case the hammer is to remain idle for a short time. If the hammer is not to be used for a longer period, the motor is cut off or the belt thrown onto the loose pulley.

These hammers are practically constructed for maximum convenience of access and operation. There are a minimum number of parts. There is only one controlling valve, of the roatry type. The frame and the base of the hammer are cast in one piece, eliminating joints. The lower die bolster or cap is made of steel and keyed in a diagonal position to permit working long bars either way of the dies. The upper die head is securely attached to the lower end of the ram.

The ram consists of a long, solid bar, full size the entire length, and takes the full force of the blow directly. It is guided both in the upper and lower cylinder heads which are far enough apart to afford maximum length of guide as well as of stroke. No piston rod packing is necessary with this hammer. The piston head is forged integral with the body of the ram, and there is no possibility of side pressure from the piston against the cylinder. Two sides of the ram are flattened at the upper end where it passes through the cylinder head, to prevent rotation of the dies.

The back stand has a footing for the motor platform. The motor is mounted directly above the driving shaft. The drive is effected by a steel cut gear and Bakelite pinion, or by a belt with a tightener. The gear type drive is shown in the illustration.

Tight and loose pulleys are provided with the belt drive to bolt directly to the line shaft. If the loose pulley is

not desired, it may be removed and a separate countershaft, with tight and loose pulleys, provided.

The table gives the specifications for the different hammer sizes.

Weight of ram, upper die and shoe.....	100 lb.	200 lb.	300 lb.	500 lb.	800 lb.	1,200 lb.
Maximum stock, worked, square.........	2½ in.	3½ in.	4½ in.	6 in.	7 in.	8 in.
Blows per minute.....................	215	195	165	140	125	115
Sizes of die surface..................	2¼ in. by 5 in.	3 in. by 7 in.	3½ in. by 8 in.	5¼ in. by 9½ in.	5½ in. by 10 in.	5¾ in. by 11 in.
Horsepower required	5	7½	10	20	30	40
Width of belt..........................	3½ in.	4 in.	5 in.	6½ in.	7½ in.	8½ in.
Total weight of hammer, approx.........	4,000 lb.	6,000 lb.	9,000 lb.	17,000 lb.	28,000 lb.	32,000 lb.

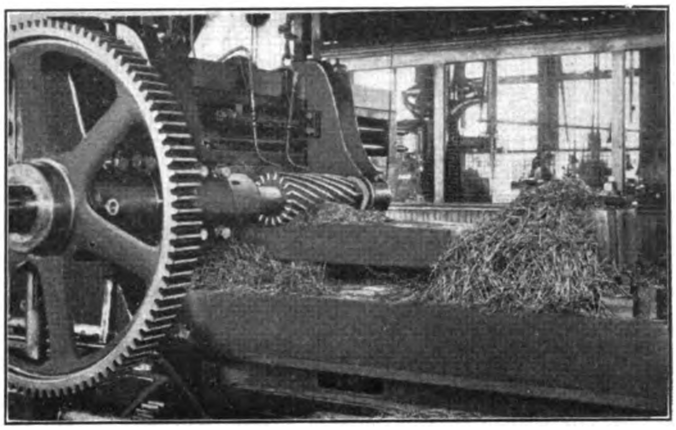
Taylor-Newbold high-speed milling cutter

THE body of the Taylor-Newbold high-speed milling cutters with inserted helical blades, manufactured by the Tabor Manufacturing Company, 6225 Tacony street, Philadelphia, Pa., is a steel forging in which under-cut helical grooves are milled. High-speed steel blades bent to conform to the back of the grooves in the body are inserted and held in place by fusible metal poured in front of the blades.

This method of holding the blades insures rigidity. After being poured the fusible metal filling is compressed, thus holding the blade firmly throughout its length.

A constant lip angle is maintained throughout, in any length of cutter; this together with the helical cutting edge reduces the tendency to chatter.

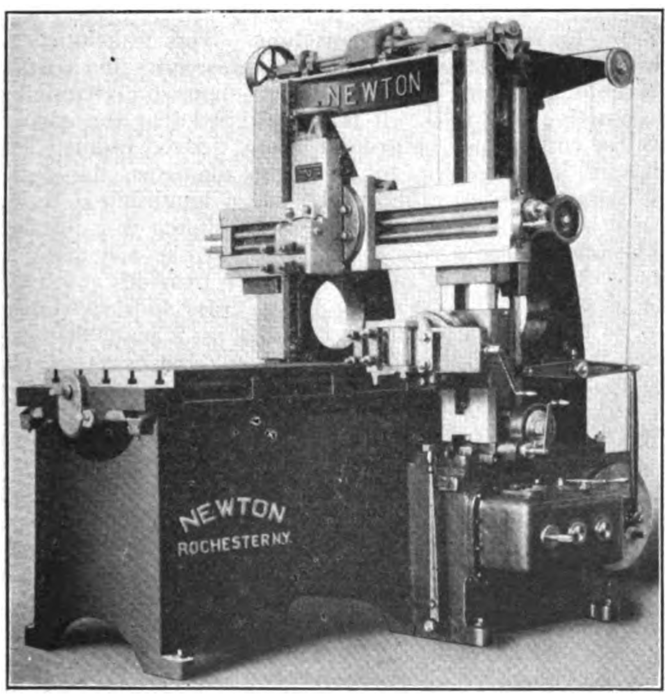
Slabbing cutters of 4 in., 6 in. and 8 in. nominal diameter are regularly carried in stock, the minimum length being not less than one diameter.



Slabbing cutter milling locomotive connecting rods

The Newton side head crank planer

THE Newton works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y., has recently developed a new side head crank planer of two sizes, one of 34-in. and the other of 39-in. stroke. This machine has, in addition to the regular rail head, an adjustable side head with vertical power feed and hand adjustment. One of these heads can be fitted to each upright if desired, thereby reducing the operating time appreciably. With the addition of one side head, production can be practically doubled.



Side head crank planer built in two sizes—34-in. and 39-in. stroke

The side head may be lowered below the top of the table when desired. It has a relief tool apron with double clamps which may be swiveled 45 deg. to either side of the zero mark. It is counterbalanced to permit easy adjustment by means of a counterweight carried to the rear of the machine and out of the way of the operator.

The table is of double plate construction with five machined tee slots and is provided with a chip pan at each end. An adjustment is available for positioning the work while the machine is stroking, which is accomplished by means of an adjustment block and screw. This block is securely clamped for the cutting operation. Six speed changes are provided, through a gear box of the sliding gear type, for changing the number of table strokes. All gears are hardened, enclosed, and run in oil. The table control is by means of a clutch and brake, permitting "jogging" for tool setting, etc. This clutch may be locked, so that the machine can not start and injure the operator.

The stroke adjustment is made from the operating side of the machine by means of a crank handle, with an indicator showing the length of the stroke in inches.

The base is a one piece casting of box type, having a closed top and provides two surface bearings for the table with side bearings and take-up gib. The uprights are also of box section and are bolted and doweled to the base and braced at the top by a deep sectional tie beam. The crossrail is adjusted by power through double lifting screws. It is of deep section and is gibbed to the uprights, to which it can be securely clamped. The tool slide in the

vertical head has equal movement above and below the bottom of the rail, thereby reducing overhang to a minimum. This head may also be swiveled 45 deg. in either direction.

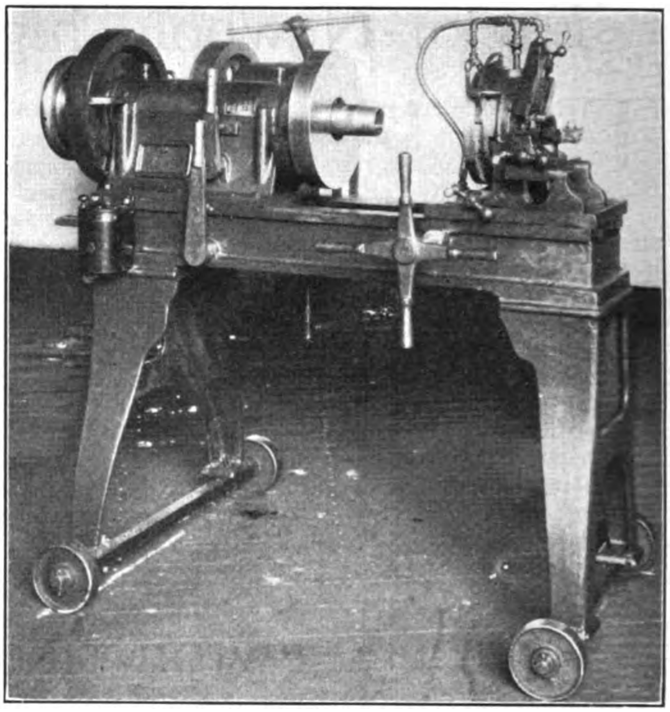
The machine can be driven by a 10-hp. 1,200-r.p.m. motor or by a single pulley through a change gear box, to a helical driving gear, the driving pinion being mounted between two bearings. This arrangement insures smooth motion. All driving bearings are bushed; essential bearings with bronze. All gears are enclosed or covered.

Portable light weight pipe threading machine

The illustration shows a pipe threading machine recently brought out by the Jarecki Manufacturing Company, Erie, Pa., which, while of compact construction and proper weight to insure steadiness, is light enough to be easily moved from place to place. On the forward end of the spindle is a three-jaw self-centering gripping chuck which securely grips the pipe while threading. At the rear of the spindle is a three-jaw self-centering chuck for steadying long pieces of pipe while being threaded. The bore of the spindle is 4 in., which allows clearance for a 3 in. pipe with couplings attached. The dies are made of a special steel. They are milled in special machines, ground to a uniform size and tempered. The four speeds for threading different sizes of pipe are obtained by shifting the two vertical levers on the operator's side of the machine.

The machine shown may be driven by a direct connected constant speed motor or belt drive, and threads pipe 1/4 in. to 3 in. with either right or left hand threads. Bolt dies 3/8 in. to 2 in. may also be used in this machine, as well as nipple holders. It is equipped with cut-off knife, swivel reaming tool and a geared oil pump.

A machine of this type, owing to its capacity, can be used in the car and locomotive repair shop for pipe work, particularly airbrake pipe. It can also be used in these shops to thread bolts up to 2 in., particularly in the erecting shop where it can be wheeled up to the locomotive.

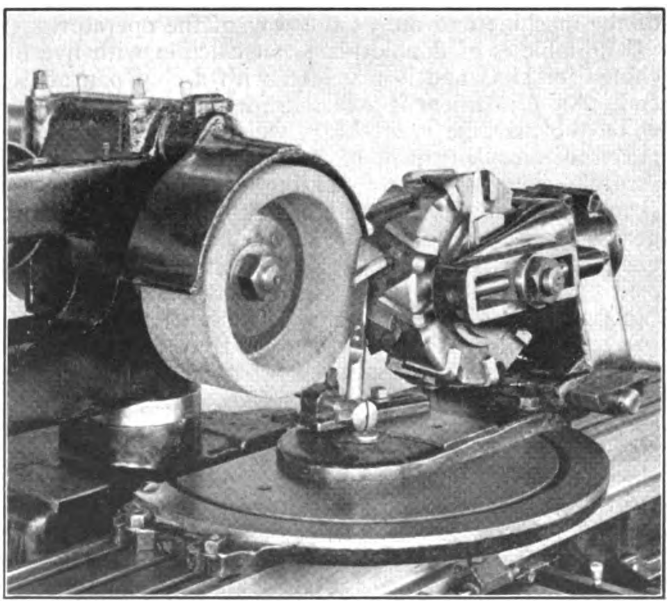


Portable machine cuts right or left-hand pipe threads

Attachment for grinding milling cutters

The Thompson Grinder Company, Springfield, Ohio, has recently developed a radius grinding attachment designed for use with its 10-in. by 36-in. universal grinding machine. This attachment is for the purpose of sharpening the faces, sides and corners of milling cutters used in railroad shops for channeling locomotive side rods. It is so designed that the corners on the cutters may be ground to any desired radius. For cutters from 3½ in. to 10 in. in diameter, the cutter is mounted on an arbor which has a longitudinal movement by means of a screw and block sliding in a bracket. The bracket has a round shank mounted in a housing so as to obtain a rotary movement which provides any angle of clearance. This housing has a cross slide movement in its base which in turn is mounted on a plate that carries the cross slide. This plate is pivoted near one end to the center of a semi-circular sub-plate, so as to give it a rotary movement in a horizontal plane through an arc of 180 deg. The sub-plate is rigidly bolted to the main top table of the grinding machine. Small end mills may be ground by removing the bracket with the round shank from the housing and inserting directly in its place an arbor having a taper hole in its end in which to insert the shank of the end mill. All movements are graduated to either thousandths or degrees and a gage is used to give the required clearance angle.

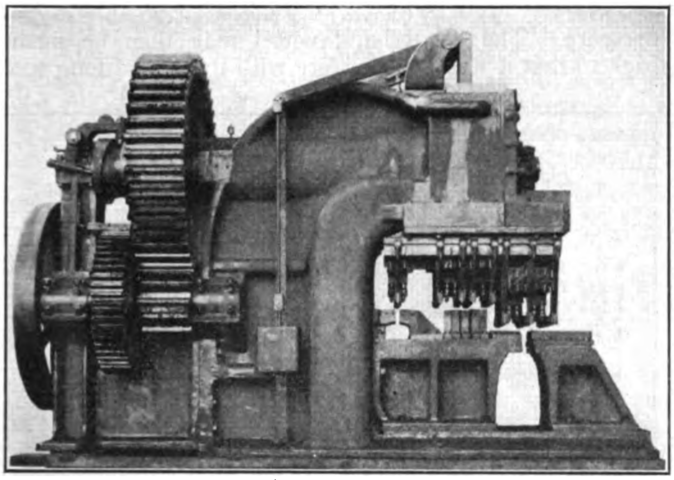
The attachment is fully universal and sufficiently flexible that the face of the cutter and the corners and one side can be ground at a single setting and the opposite side ground by taking the cutter off of the arbor and remounting with the opposite side out.



Side rod channeling cutters may be ground on the face, sides and corners

Open gap punching machine

ITS large size, the wide range of work that it will handle, and the fact that it will punch both flanges and webs without changing tools, are outstanding features of a new punching machine that has been brought out by the Cleveland Punch and Shear Works Company, Cleveland, Ohio. The capacity is for punching 8-in. to 30-in. Bethlehem girder beams in the flange and web without changing tools. Bethlehem H-beams ranging in size from 8 in. to 14 in., may be punched, and by placing an overhanger at the rear of the throat, standard 6-in. to 9-in. H-beams and standard I-beams may be punched without changing other set-ups of tools. The machine may be used also for punching plates.



A wide variety of work may be performed on this punching machine without tool changes

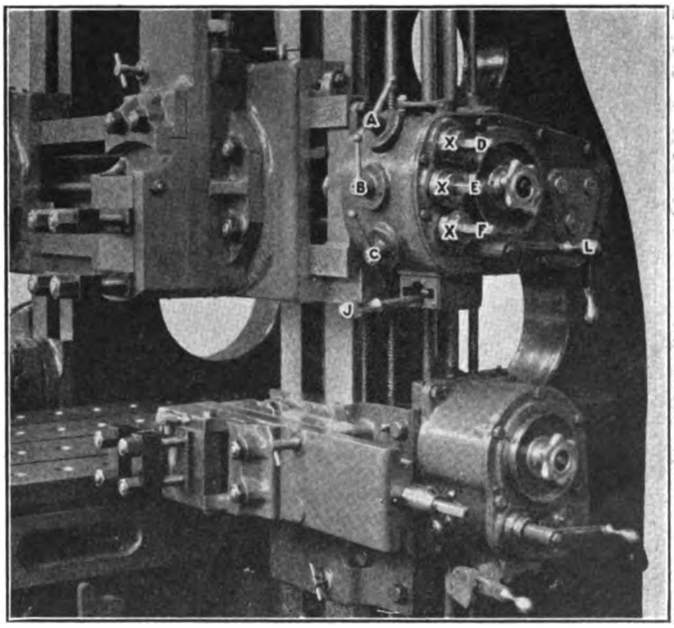
The punching tools are arranged in three standardized rows parallel to the main shaft. With the distance between the rows fixed and standardized, connecting angles can be punched with the same set-up as employed for the webs and flanges. The punching tools are adjustable from a minimum of 2¼ in. to a maximum of 48 in. The strippers are adjustable and may be set up to clear the flange and web without change. The stripper arms are attached by a single bolt. The frame is a solid casting of the I beam type of construction. The drive is of the double-gear type, and an automatic clutch of the safety type is employed to prevent a repeat stroke. The gears are of steel with cut teeth, and the jaw plate for the gears is a separate steel casting tongued and bolted on. All gears are bronze bushed. A safety feature is found in the elimination of an overhead counterweight. In its place are two counterweights, one on each side at the rear of the throat, these being guided on vertical rods.

The machine is driven by a direct-connected 40-hp. motor. The compactness of the driving end of the machine may be noted from the illustration and saving of floor space is a feature of this design. The over-all dimensions are: height, 15 ft. 3 in.; length, 15 ft. 9½ in.

Larger planer has convenient controls

ONE of the outstanding features of the 42-in. Hypro planer, recently brought out by the Cincinnati Planer Company, Cincinnati, O., is its adaptability for rapid manipulation with provision for safeguarding all movements. The general features of design on this machine are similar to one of a somewhat lesser capacity which was described in the *Railway Mechanical Engineer* for September, 1925, page 587. The illustration shows a close-up of the operator's side of the machine and gives a good idea of the convenience of the controls. Three levers, *A, B* and *C,* shown with round-knobbed handles control the direction of the head; the upper lever for the traverse of the left-hand head, the center lever for the vertical travel common to both heads and the lower for the traverse of right-hand head. These levers have three positions: in toward the planer to move both the heads down and either one or both away from the operator; up straight for neutral and no head movement, and out from the planer to move both heads up and either one or both toward the operator. The horizontal-travel lead screws, *D, E* and *F,* and the vertical-travel splined shaft project from the head and are squared so they may be operated by hand. The feed is set by the feed adjusting knob *G* and is connected when desired by turning the small feed engaging levers *X, X, X* at the base of each shaft. Safety stop levers are provided on both rail heads automatically to stop further movement at the limit of travel of the heads outward or toward each other, should the operator set them in motion and neglect to stop them himself. The straight levers *J* and *K* control the rapid motions of the rail and heads. Automatic stops further guard the rail movements at the extremes of its travel.

The detachable crank *L* just below the three square shaft ends controls a locking device between the rail and the planer housing, one turn operating a powerful toggle to pinch the clamps against the housing. This movement



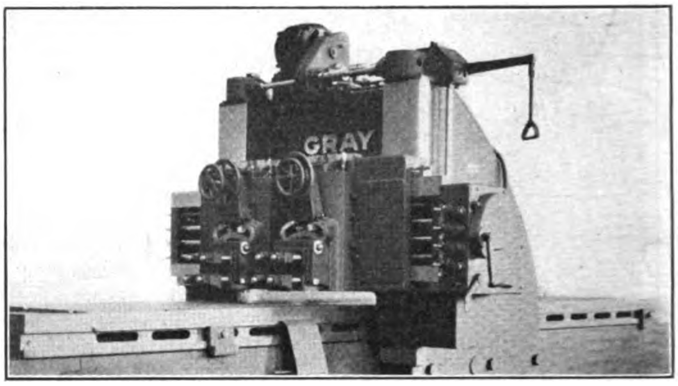
The controls are designed for rapid manipulation and the prevention of false movements

interlocks with the rail-lift control so that it then becomes inoperative. The lever *K* at the lower edge of the illus-

tration operates the side head lift. Thus, all movements and setting can be made from the operator's position by hand, by power feed or rapid traverse as he may elect, without fear that he may get hold of the wrong lever or forgot to bring to a stop a movement that he may have started.

Quick set apron for switch planer

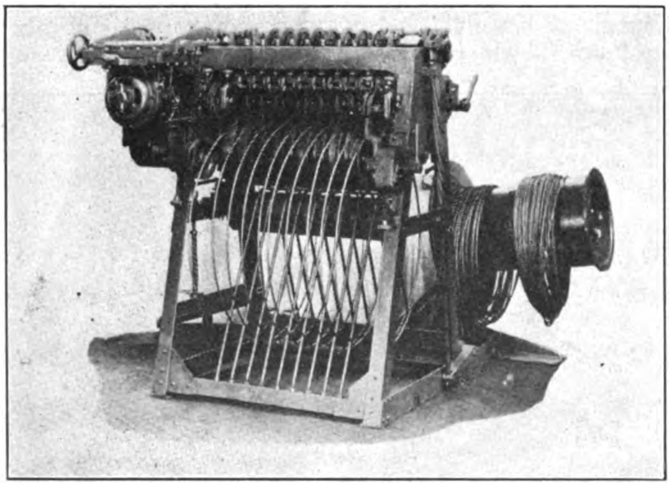
THE G. A. Gray Company, Cincinnati, Ohio, have recently made an improvement in the Gray switch planer by adding a quick set apron. The service required of this machine frequently involves changing of cuts in open hearth steel rails of 130-lb. section. The heads and the tool boxes must of necessity be of heavy rigid construction and at the same time must be capable of easy movement on the part of the operator. On this new quick set apron a double hand wheel device is provided on the front of the head. The operator first loosens the tool box by turning the large hand wheel—the small hand wheel can then be pulled out from the large one to make it more convenient to handle and when rotating, swivels the tool box to the desired angle. As a partial turn of the hand wheel gives the maximum travel of the tool box to one side or the other, the tools can be quickly swiveled to the desired angle. The operator then clamps the tool box with the large hand wheel and in the case of very heavy cuts can use a wrench on the hexagon shaped hub of the hand wheel to secure the final clamping pressure. The small hand wheel may then be pushed back so that it will not interfere with the use of long tools.



The small hand wheel controls the mechanism which swivels the tool box

Semi-hot automatic feed bolt heading machine

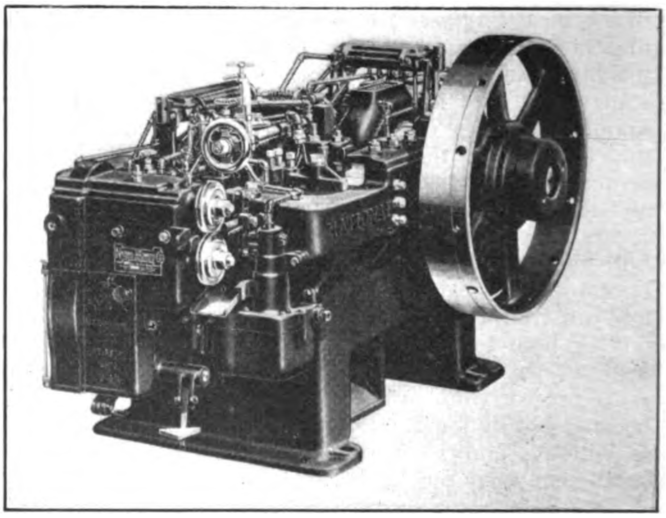
ABOUT five years ago the National Machinery Company, Tiffin, Ohio, started the development of the semi-hot or low temperature bolt heading machines at which time it designed and built eight machines of 1 in. rated size, described on page 187 in the March, 1923, issue of the *Railway Mechanical Engineer*, for making all classes of machine bolts. The design of the bed frame was such that spring was practically eliminated, so that it was not necessary to over-pack the grip dies or have the heading tool pound the grip dies in order to secure well filled heads, even when making semi-hot or low temperature work. Slides about twice as long as used heretofore with the National suspended type bearings were employed, and provisions made for maintaining highly accurate alinement. The feeding mechanism and shear were at an angle to the machine, and this compensated for the distortion encountered in hot shearing.



The national coiler for use with the automatic heading machines

The 3/8-in. and 5/8-in. size machines were recently brought out by this company. The 3/8-in. machine makes a wide variety of single blow work, up to 3/8-in. in diameter by 4 1/2 in. in length, by the semi-hot method. Many jobs which in a cold header require two blows and sometimes three blows, are made with but a single blow on this machine.

A long furnace with a small heating chamber is employed, and the stock is taken off the original coil and looped or rewound into coils of large diameter, by the new National coiler, shown in one of the illustrations. In conjunction



National semi-hot automatic feed rivet and bolt heading machine

with this coiler, an electric butt welder is employed, so that one coil is joined to the other, thus providing a continuous operation. In this design single feed rolls of large diameter are used in place of the double rolls as in the larger machines.

The ⅝-in. automatic feed machine is used for making all classes of single blow bolts, rivets and upsets ⅝ in. in diameter by 7 in. in length. It has a speed range of 120 to 150 r.p.m.

The heading slide is unusual, being of greater length than the distance from the main shaft to the breast plate of the machine. This over-arm suspended type slide also has bearings back of the crank. This back bearing in reality guides the front end of the slide, and prevents the heading tool from "winking," or being thrown out of alinement when making bolts or other jobs requiring a large amount of stock.

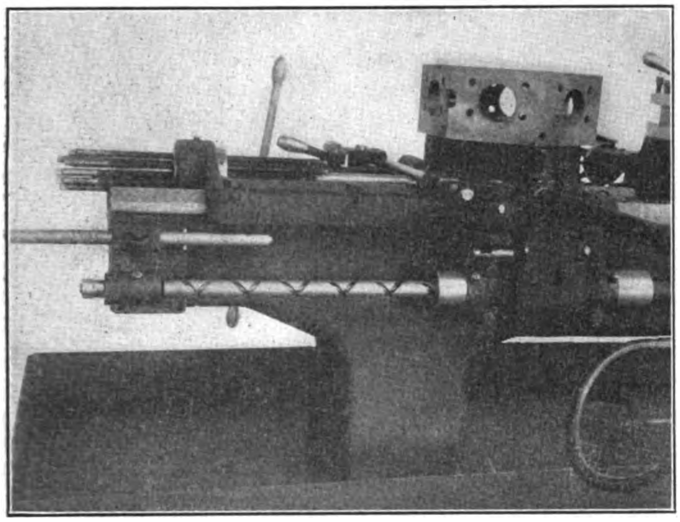
A new type of grip relief mechanism is employed, which, while providing all the gripping pressure required for the most difficult work, limits the ultimate pressure obtainable so that the working faces of the gripping dies cannot be battered and prematurely worn out.

The gripping toggles in this design are placed horizontally, as this enables extra large diameter pins to be used and yet keeps the design compact. At the same time it enables perfect lubrication, as both ends can be successfully reached by the automatic oilers.

These machines follow essentially the same features of construction and operation as the 1-in. machine previously described.

No. 1-B universal turret lathe

THE Foster Machine Company, Elkhart, Ind., has brought out a new universal turret lathe, known as No. 1-B, in which are incorporated a split ring type binder for the hexagon turret, a power rapid traverse unit for the turret slide, and a bed of increased length to effect greater longitudinal feeding movements of the carriage and the turret slide. The swing over the ways and cross slide is also increased, giving greater chucking capacity than on the earlier machines of this company.



The turret head and stops of the Foster No. 1-B universal turret lathe

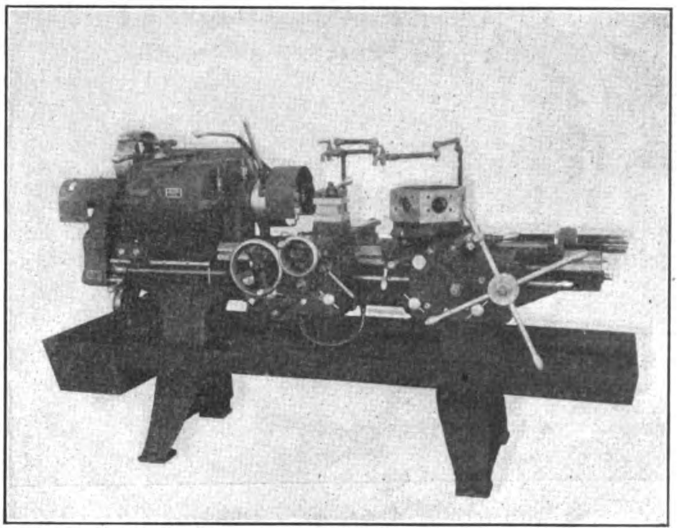
The turret binder grips almost entirely around the turret on a very large diameter. The same lever operating the turret binder releases the lock bolt.

The power rapid traverse unit is mounted on the rear of the saddle and is controlled by a lever within easy reach of the operator. The rearward movement of the rapid traverse can be automatically stopped at predetermined points. The clutches for operating this mechanism are of large diameter. The friction contact is bronze against close grained cast iron. Through an interlocking mechanism the turnstile for traveling the turret slide by hand is automatically disengaged and does not revolve under any movement, forward or back, set up by the power rapid traverse.

The cross slide extends entirely across the bed and has an effective cross travel of 10 in. It will carry a cutting tool past the center of the spindle. On the rear of the cross slide a pad is provided for mounting tools on the back side of work. The swing over the cross slide is 9½ in.

Twelve power feed changes, reversible, are obtainable for the cross movement. The longitudinal feeding movement to the carriage is 32 in. with 12 feed changes which are independent of those for the turret saddle. Six adjustable independent stops which may be indexed are provided for automatically stopping the longitudinal feeding movements of the carriage.

The turret has an effective turning movement of 32 in. and 12 feed changes, the latter independent of those for the cross slide and carriage. The lock bolt is of considerable length and located to give the greatest support to the turret face carrying the tool that is in action. The turret is of the hollow hexagon type and is tapped for independent pipe lines to each face. The independent stop screws are carried in a spool in the rear of the saddle and index in time with the turret faces. The stop screws shut



The Foster 1-B universal turret lathe equipped with a Foster-Baker automatic chuck

a slidable stop which is also adjustable and retained by a spring locking key. This eliminates the necessity of lengthy adjustments of the stop screws.

The carriage and saddle aprons are of the double plate type and all the gears therein except the worm gears, which are of hard bronze, are steel and run in oil. The

clutches are of large diameter, adjusted from the outside.

The spindle is turned from a chromium manganeese forging. The spindle nose has a large diameter of thread, a large diameter pilot and very short overhang. The hole through the spindle is 2⅝ in. The spindle revolves in special bronze bearings. The gears in the head are machined from steel forgings, heat treated, and run in a bath of oil. Through the gear combinations effected by the movement of four levers, 12 spindle speeds are obtainable. These are reversible and range in geometrical progression from 20 to 480 r.p.m. The shafts carrying the sliding gears are of chrome nickel steel heat treated. They are splined in place of being keyed to drive the gears.

The automatic chuck is of the master collet type with a capacity of 2-in. round bars. The final closing action of the collet is effected by a toggle action. The mechanism can be supplied for either draw-in or push-out type collets.

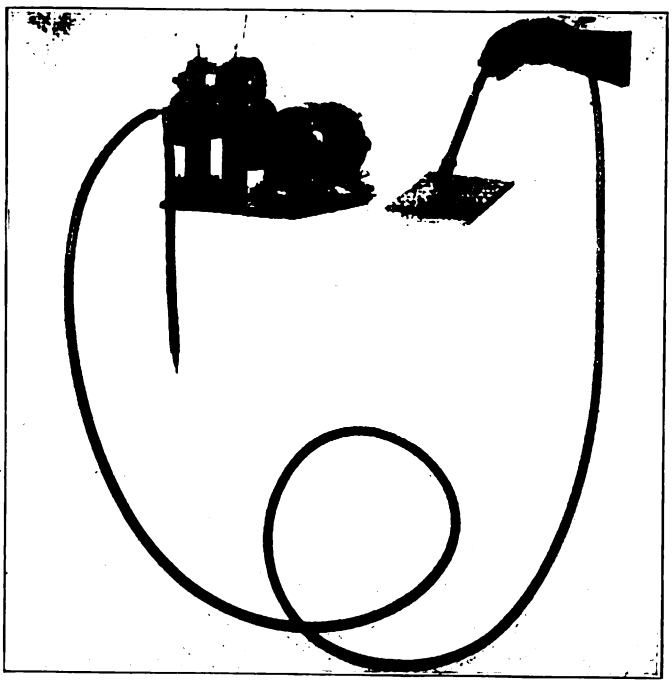
The bed is of the double ribbed girder type, heavily reinforced, and is cast integral with the head. The swing over the bed is 17 in. The drive may be either from a countershaft regularly supplied with machines not ordered with direct motor drive, or directly from a motor mounted on the rear of the leg, or on top of the head. A 5-hp., 1,200 r.p.m. motor of any make may be used.

A threading attachment of the leader and follower type can be supplied for this machine. With one gear shift each leader and follower enables two pitches of thread to be cut, which are one and four times the pitch of the follower. A taper attachment capable of turning any taper up to 3 in. per foot can also be supplied.

Electric arc welding in gaseous atmosphere

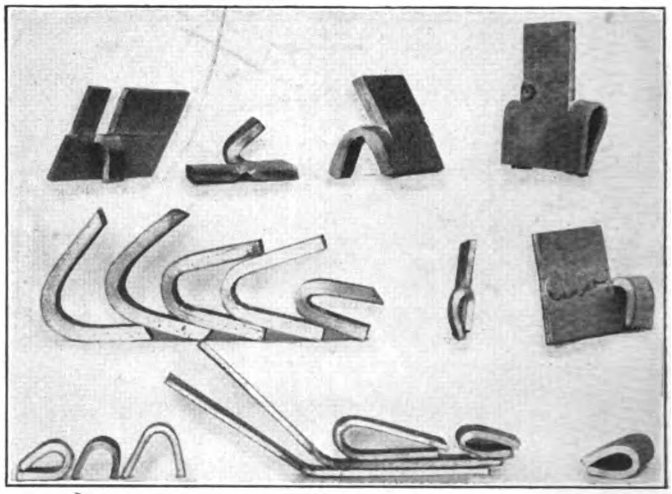
BY surrounding the ordinary welding electrodes with an atmosphere of hydrogen or certain other gases, it has been found by Peter Alexander of the Thomson Research Laboratory of the General Electric Company, Lynn, Mass., that it is possible to produce ductile welds. The gas acts as a flux and shield against the oxygen and nitrogen of the air; therefore, the formation of oxides and nitrides of iron in the molten metal is prevented. The process originated from the study of metallurgy of the arc-deposited metal and the causes that limit its ductility.

The method is based on the action of molecular hydrogen. This gas at high temperatures, even in the molecular state, is a very active reducing agent. When it surrounds the crater of the arc it acts in the same way as it does in the hydrogen brazing process. Yet certain peculiarities of the process—for example, the extremely high voltage drop at the cathode and anode of the arc burning in hydrogen—are due to the dissociation of the small amounts of molecular hydrogen in actual contact with the craters. Hence the apparent resistance of the arc, and consequently the amount of energy liberated, is about double that when the arc is burning in air.



Automatic wire feeding device with attachment for welding in hydrogen atmosphere

Consequently the weld is not only ductile, but the operation is much faster. The speed results both from the greater energy of the arc in the hydrogen atmosphere and the fact that the beveling of the edges of the material is unnecessary. Using 180 amperes and an arc voltage of 60, ¼-in. boiler plates, butted together without beveling, have been welded at a speed of 60 ft. per hour.

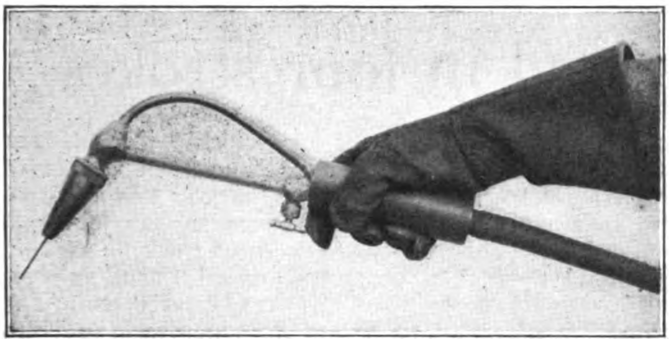


Transverse bends on samples of arc welds produced with a semi-automatic machine in hydrogen atmosphere

Ductility is a factor of prime importance in the welds of structures that are subjected to vibration, accidental bending stress, or overload. Also, ductility equalizes internal cooling stresses when present in the weld. If any part of the ductile weld is stressed beyond its elastic limit, it will not crack. It will yield until the stresses are more or less equalized all along the joint, which is so proportioned as to stand with safety the imposed load. It has also been found that the metal deposited in the hydrogen atmosphere has a higher elastic limit. The elastic limit of pure iron electrodes before deposition averages 29,000 lb. per sq. in.; the elastic limit of the same electrode deposited by the arc in hydrogen averages 42,000 lb. per sq. in.

In this welding process the arc is maintained inside of a hydrogen stream which burns along its outer surface of contact with air. The electrode is entirely surrounded by hydrogen, which eliminates the possibility of the metal

in the crater coming in contact with air. Direct current is used. The equipment as developed in the laboratory includes the direct-current generator, gas hose, and spool of welding wire mounted as a unit on one base. The



Torch for welding in hydrogen with a metallic electrode

welding wire, the hydrogen gas and the electric current are sent through a flexible hose to the torch nozzle.

After the work with the hydrogen atmosphere was found to be successful, experiments with mixtures of hydrogen and carbon monoxide were conducted in accordance with Professor Elihu Thomson's suggestion, and under his personal guidance. Water gas, containing about equal volumes of hydrogen and carbon monoxide, was next tried. It was found that welds produced in such an atmosphere were ductile and easier to produce. Work with various mixtures of carbon monoxide and hydrogen, produced either synthetically or by decomposition of various organic compounds, demonstrated that ductile welds can be produced in the atmosphere of any mixture of the two gases. Methanol or synthetic wood alcohol was found to serve well in this gas, so that transportation with portable outfits is facilitated.

A series of experiments with nitrogen-hydrogen mixtures showed that mixtures of these gases also give ductile welds. The use of liquid anhydrous ammonia which contains one volume of nitrogen and three of hydrogen, in this connection makes it possible to store large quantities of the gas in small volume as a liquid.

In its present state the process is being extended to the welding of alloy steels, non-ferrous materials and their alloys. The careful selection of the appropriate gaseous mixture determined by the nature of the materials to be welded is an essential factor for successful work.

Type M. S. O. automatic link grinder

THE M.S.O. automatic link grinder sold by the Marburg Brothers, Incorporated, 90 West street, New York, is provided with an attachment which holds the link so that it can swing around a center which is adjustable within certain limits. The attachment is connected to the work table, which is specially designed and which has an automatic lateral motion, in such a manner that the swinging motion is secured. The automatic reverse stops at the ends of the table motion are adjustable for different lengths of slots.

The link is held on its support by two angle irons or in two vises both of which are regularly supplied with the machine. For grinding of the link, a wheel of about 2 in. in diameter is generally used and the grinding head is adjusted to a slight longitudinal travel which is automatically reversed.

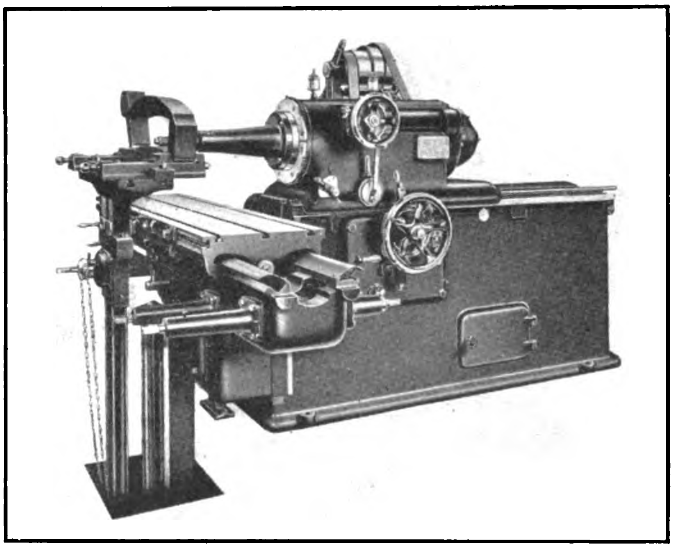
The grinder is arranged, furthermore, for grinding bushings and similar parts, in which case the upper part of the radial link support is removed. The bushings are fastened to the table by suitable supports which vary with the size and designs of bushings. Bushings which are not removable but fastened in levers, rods, etc., can readily be ground. The grinding of a number of bushings can be done in one setting as long as the maximum center distance is within the limits of the machine.

For the purpose of grinding pins a special attachment is used which can be furnished with the machine. This attachment is bolted to the grinding head in the place of the regular spindle used for grinding link motions, cylinders, etc. Removing the grinding spindle and mounting the special attachment requires only a few minutes.

The grinder is suitable for grinding brake cylinders, air compressor cylinders and steam chests within the limits given in the specification. The grinder is equipped with single pulley and gear drive. It is, therefore, equally well suited for individual motor drive and for a drive from a transmission.

The gear box for the drive of the grinding head is enclosed. The speed of the longitudinal travel is under the control of a single lever and requires no change of belt. All operating levers are located so that they can easily be reached by the operator without change of position.

The main guides are suitably protected against grinding dust. A central oiling system takes care of the lubrication as far as feasible so that only a few points require independent attention.



A grinder designed to grind valve motion links, bushings, pins and airbrake cylinders

The dimensions and capacity of the machine are as follows:

Maximum grinding length	20 in.
Maximum grinding diameter	12 in.
Maximum eccentric motion of spindle, diameter	1¼ in.
Size of work table	59 in. by 16 in.
Maximum lateral motion of work table	39½ in.
Maximum distance center of grinding head to work table	12⅝ in.
Minimum distance center of grinding head to work table	6 5/15 in.
Maximum longitudinal travel of grinding head	35½ in.
Radius of link	29½ in. to. 89 in.
Maximum length of slot at radius of 89 in.	29½ in.

Maximum length of slot at radius of 29½ in.	19⅝ in.
Maximum diameter of pins (pin grinding attachment)	3⅛ in.
Maximum length of pins (pin grinding attachment)	4¾ in.
Number of speeds of longitudinal travel	3
Number of grinding wheel speeds	4
Dimensions of driving pulley of machine	11.8 in. by 4 in.
Speed of driving pulley	650 r.p.m.
Floor space required	9 ft. by 8 ft.
Power required	4 ft.
Net weight, approximately	6,600 lb.

Lift truck which raises load in four strokes

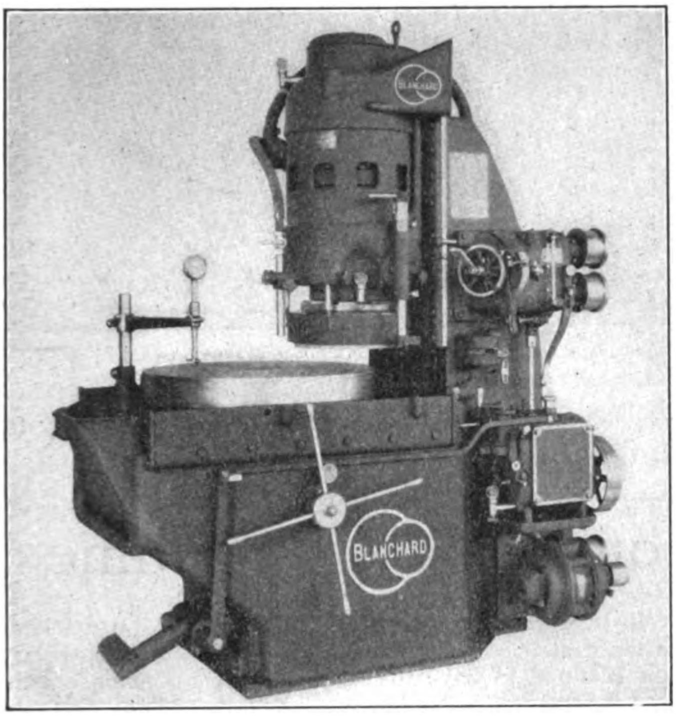
In order to meet the demand for industrial trucks capable of handling heavier loads the Stuebing-Cowan Company, Cincinnati, Ohio, has recently placed on the market a mechanical lift truck which, while similar in many respects to earlier trucks designed by this company, has the added advantage of a four-motion multiple lift. This truck, known as the K model has a lifting leverage of 48 to 1. The lift is accomplished through four strokes of the lifting and pulling handle. A feature of this type of truck is the fact that the load may be lifted by operating the lifting handle from any angle within 360 degrees. This particular design of truck, in keeping with the type of construction used on other trucks manufactured by this company, is of all steel construction. The frame is made up of bar steel used edgewise in order to provide lightness and at the same time maximum strength. This steel rail provides a one-piece bearing for the link, studs and axles. The wheels are of steel with axles of high carbon heat-treated steel mounted in Hyatt roller bearings specially designed for efficient lubrication. The steering column is mounted in Timken thrust bearings. The lifting mechanism of the K model truck is of the mechanical type, a feature of which is a lock, independent of the lifting lever (steering handle), which locks the elevated load securely in place. There is no chance for the handle to fly up under the impulse of a load. This locking feature is automatic and embodies no springs of any kind. The only means of release is by pressure on a steel pedal which disengages the locking mechanism. The entire lifting mechanism is enclosed and runs in a bath of oil.

The K model truck is manufactured in 12 sizes intended for loads of from 5,000 to 6,000 lb. and, used in conjunction with Stuebing steel-bonded platforms, may be adapted to a wide range of shop material handling conditions. This truck may also be used as a trailer for service with tractor equipment. It can be used to advantage for hauling material from the erecting pits to the cleaning vats. After the work is cleaned the truck can pick up the loaded boxes and deliver them to the repair gangs. It can also be used by the stores department.

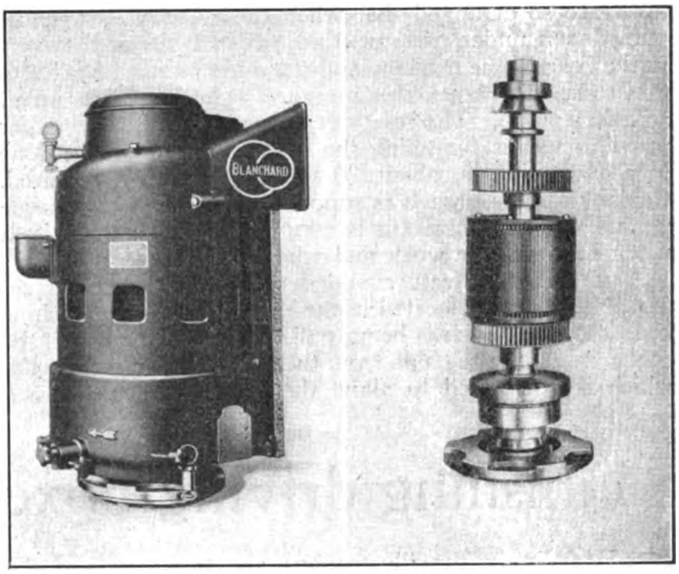
Stuebing-Cowan quick raising platform truck

Ball bearing wheel head for surface grinder

THE wheel head of the direct motor drive type of the No. 16 Blanchard vertical surface grinder built by Blanchard Machine Company, 64 State street, Cambridge, Mass., has recently been improved and simplified. The spindle is now carried on two large ball bearings in the sliding wheel head, with the upper bearing held up by springs which take up all end play and place a considerable thrust load in an upward direction on the lower or main bearing at all times. The bearings are of the Gurney, radial thrust type, and have capacities greater than the loads they are designed to carry. The lower bearing has 11 balls 1⅝ in. in diameter. The upper bearing is entirely covered and has no moving parts exposed at the top of the head. The wheel guard is held directly in the head, eliminating the spider casting formerly required in the older types of machines. Hexagon head ½-in. screws secure the wheel rings to the faceplate.



The No. 16 Blanchard grinder, direct motor drive type



At the left may be seen the new ball bearing wheel head and at the right the wheel head spindle

The older type of spindle, now used on the belt driven machines only, had the spring take-up feature but used four bearings.

Hydraulic broaching machine

A VARIABLE-SPEED hydraulic broaching machine, known by the designation No. 3L, has recently been brought out by the J. N. Lapointe Company, New London, Conn. In this machine, the cutting speed can be varied up to 24 ft. per minute, with a fast return speed of 60 ft. per minute. If desired, the return speed can also be varied from 10 to 180 ft. per minute. The speed changes can be made while the machine is running or when it is stopped, only a few seconds being required to adjust the machine to any predetermined rate of speed. The control arrangement is mounted on a control shaft which runs parallel to the crosshead ways and which can be locked at any cutting speed required.

The total stroke of the draw-rod is 56 in., the machine being provided with an automatic stop for controlling the length of the stroke. This stop is of the spring and plunger type and requires no wrench for its adjustment; it can also be set at will, for automatic return. Not only does this stop permit a variation of the stroke, but complete control is also provided by a hand-lever which permits the ram to be stopped or started in any position, either on the cutting or return stroke.

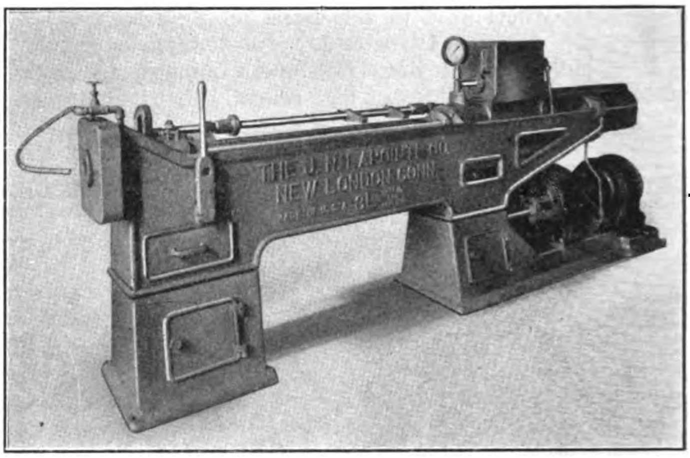
The machine, being built on the hydraulic principle, is provided with a low-pressure relief valve which automatically opens when the ram meets with undue resistance. This feature prevents the broach from being broken in case it should be backed up against the inside of the faceplate. The pressure for the hydraulic system is supplied by a Hele-Shaw variable-delivery multi-plunger hydraulic pump, made by the American Fluid Motors Company, Philadelphia, Pa. Each pump is subjected to a thorough test, before being installed, at a pressure of 1,500 lbs. per sq. in. For driving the pump, either a countershaft or a direct-connected electric motor drive may be used, a 7½ hp. motor being recommended. The speed of the pump is 900 r.p.m. The base for the motor is arranged to take any make of motor.

The ports are cored in the pressure cylinder to eliminate piping and possible leakage. Only two pipes are used in the entire hydraulic system, and these are made of extra heavy copper, neither being over 27 in. in length. The fast return valve is cast separate from the main cylinder, and all cored recesses are machined. The cylinder is 7 in. in internal diameter, and is mounted on the rear end of the machine bed, being bolted at its forward end to a cross-piece which is cast integral with the bed. At a pressure of 1,000 lb. per sq. in., which is the maximum pressure recommended and that for which the relief valve in the

pump is set, a pull of 31,400 lb. is exerted on the draw-rod.

A system of linkage connects the operating lever and the control shaft with the pump. The latter is directly connected to an automatic valve, which, during the return stroke of the ram, permits the oil that produces the pressure on the cutting stroke to be transferred from one side of the piston to the other without passing through the pump. A reservoir above the pressure cylinder accommodates the excess oil during the working stroke. Connections are so arranged that when the relief valves in the pump open under pressure they exhaust into a reservoir in the base of the machine and the oil is pumped back into the reservoir above the pressure cylinder by a small auxiliary pump. The reservoir above the pressure cylinder provides means for filling the system, which can be done in a few minutes, about 20 gal. of oil being required. Coolant for the broach is supplied by a Brown & Sharpe geared pump. Lubricant is supplied to the broach, both when it enters the work and when it is leaving.

A time-saving feature added to the machine is a removable chip pan, located in the front part of the machine bed. As the broach is being pulled through the work, the coolant washes the chips from the tool down into this pan, which is perforated to allow the coolant to pass into a reservoir. As standard equipment the machine is provided with one reducing and one pull bushing. It

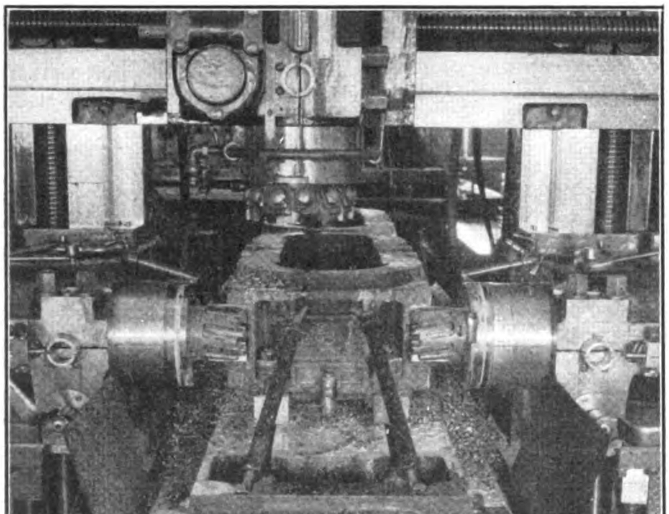


La Pointe broaching machine

weighs 6,000 lb., and occupies a floor space of 12½ ft. by 26 in.

Finishing driving boxes on a milling machine

SHOWN in the illustrations are two views of the three-head adjustable rail milling machine, manufactured by the Ingersoll Milling Machine Company, Rockford, Ill., finishing the faces, and shoe and wedge fits of locomotive driving boxes. This machine has been

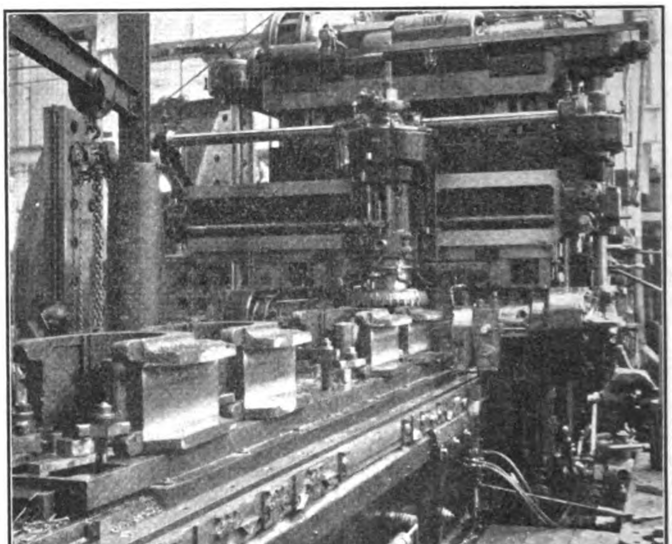


The two special cutters are just finishing the final pass on the shoe and wedge fit—The cutter in the vertical head is raised after finishing the faces

especially designed for such work. The bed is the full width of the table and the housings and rail have wide bearing surfaces. The saddles are of heavy construction and are equipped with 6-in. spindles. The gears in the horizontal heads are 16 in., and the gear in the vertical head, 20 in. in pitch diameter. All the gears are hardened forgings throughout, enclosed and running in oil. The machine is driven by a 40-hp. motor through 3¼-in. shafting which provides ample power for heavy milling.

The vertical feed of the two side heads may be controlled by hand, the operator being guided by markers fastened at the side of the table. The machine, however, can be fitted to have this feed control automatic. This feed is actuated by the dogs shown on the side of the table in one of the illustrations. When automatic feed is provided, the operator is able to load and unload the driving boxes while the machine is in operation, taking the boxes off the rear of the table while those at the front are being milled and vice versa, thus saving considerable time.

Tests conducted by the manufacturer showed that a



A large type "S" cutter is used in the vertical head for milling the faces—The special type end mills are shown in position to mill the taper angles

driving box could be milled complete in 52½ minutes, floor to floor. This time included milling both faces, the edges of the flanges and both the shoe and wedge fits including all taper angles. The boxes were milled com-

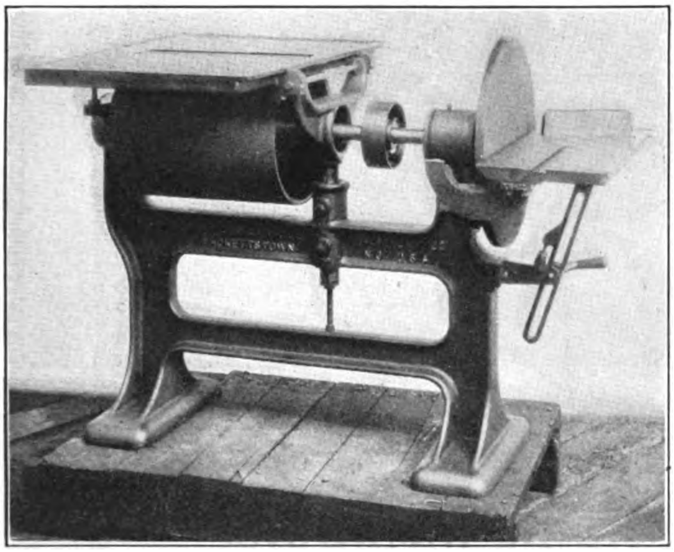
plete from the rough in two settings. In the first setting one face and the outside edges of the four flanges are milled. This is done with the vertical head in one or two passes, depending on the width of the face. The boxes are then turned over and set on the face finished in the previous operation. The first pass or two passes mill the opposite face as in the first setting. Special end mills are used in the two horizontal heads for milling the shoe and wedge fits at the same time, including the taper angles as shown in one of the illustrations. This is done by means of the power vertical feed on the horizontal heads which can be thrown in or out, and reversed independently of the double feed. The combination of the two feeds, mills the taper, the angle of which can be varied by means of pick-off gearing. Milling the shoe and wedge fits requires two passes. The first pass mills half the bottom and one set of tapers, the second finishing the bottom and the other taper.

As shown in one of the illustrations, these tests were performed with four boxes mounted on the table in an experimental fixture. They may, however, be mounted in a fixture for holding more than this number.

This milling machine can be used as a general purpose machine for face milling iron or steel castings. It can also be fitted with an arbor driven from one or both of the horizontal heads and used for such work as milling shoes and wedges, crossheads, or any other work requiring arbor milling.

Two machine tools for the woodmill

THE American Saw Mill Machinery Company, Hackettstown, N. J., have placed on the market a bench band saw and a drum and disc sander which are especially adapted for use in the woodmill of a railroad shop. The band saw may be operated by belt or by electric motor from the lighting circuit. The frame is constructed to insure maximum rigidity and strength without being unduly heavy. The wheels are balanced and equipped with rubber bands and the table is made of cast iron, equipped with a babbitted throat for the saw. It may be tilted to any angle up to 45 deg. and is held by a positive clamp. The alinement of the upper wheel is maintained by means of a convenient hand wheel and the saw may be lined on the wheel when the machine is in motion. The lower wheel is also adjustable for alinement. The tension of the saw is regulated by means of a hand wheel, screw and compensating spring, and may also be adjusted while the saw is in motion.

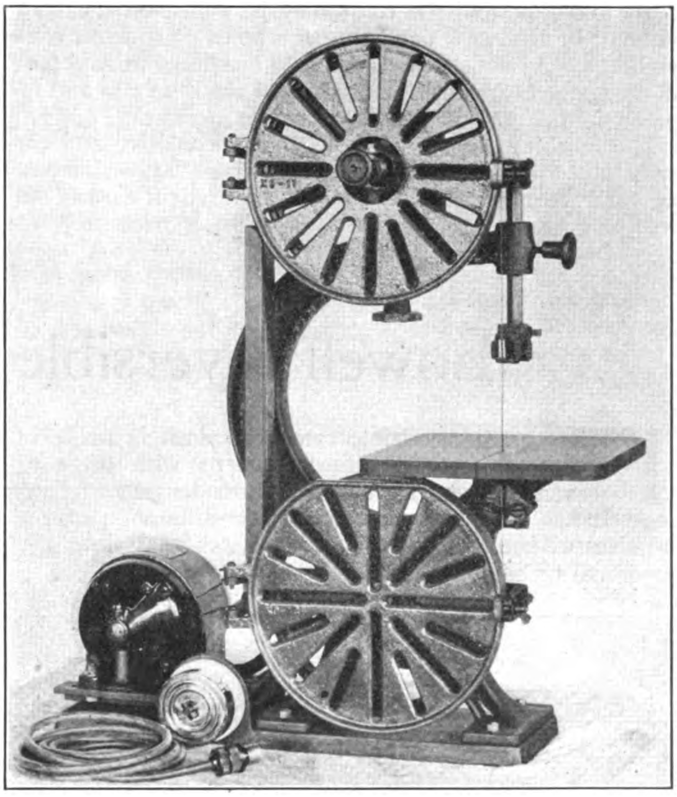


Combined drum and disc sander for sanding flat or bent work

The wheel guards are hinged to rigid frames and are locked in place by thumb nuts. The saw is further protected by a long guard placed at the back between the upper and lower wheels. The machine is regularly equipped with a plain guide above and below the table. A roller guide above the table, however, can be furnished if desired. Machines equipped with electric motors have the motor and starting switch mounted on a cast iron sub-base to which the machine is also attached, making a self contained unit. A small endless belt from the motor drives the lower shaft.

The height of the machine with the sub-base is 36 in. and without the sub-base 34¾ in. The overall width is 16 in. and the table is 12 in. by 12 in. The wheels are 12 in. in diameter with a 1 in. face. The guide is adjustable as to height and may be raised to a height of 6 in. above the table. The saw wheels operate at a speed of about 800 r.p.m.

The combined drum and disc sander is designed for use for sanding straight or bent work on the drum or for general disc sanding. The drum is 13 in. in diameter with a 16-in. face and is provided with groove and clamping strip to hold and stretch the sand paper and carpet. One end of the carpet is fastened to the drum, the other end being clamped with the paper. The drum table, 21 in. by 32 in., is provided with a suitable opening for the drum,



Bench type band saw equipped for electric motor drive

and is adjusted by means of screws to the required position for flat sanding. The table may be removed for sanding curves and work of a similar nature. The disc is 18 in. in diameter and is accurately turned and balanced. The disc table is 10 in. by 25 in., and is adjustable to any angle up to 45 deg. in either direction. It is fitted with a grove and miter fence for sanding angular work. The main frame is cast in one piece of sufficient weight and strength to prevent vibration. The arbor runs in ball bearings and is regularly equipped with a pulley 6 in. in diameter and 4 in. wide. The floor space occupied by this machine is 49 in. by 32 in. It is recommended for use with a 2-hp. motor which will operate the sanders at an arbor speed of about 1,000 r.p.m.

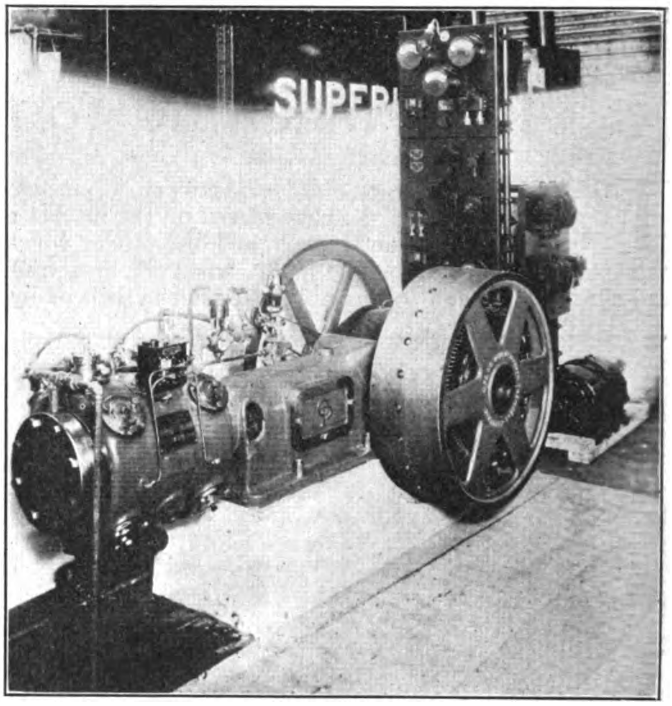
Fly wheel synchronous motor

A FLY-WHEEL type of synchronous motor in which the fields and the rotor revolve outside the stator, has been placed on the market by the Ideal Electric & Manufacturing Company, Mansfield, Ohio. These overhung synchronous motors are particularly adapted for air and ammonia compressors. They are limited in horsepower rating from 15 to 100 hp. and speeds from 164 to 400 r.p.m. The machines may also be used as alternating current generators to be driven by small steam engines, oil engines or gas engines. It can be used for the latter purpose in almost any railway shop.

In several cases where it was desirable to obtain a large fly wheel effect, it was found practical to build a double-rim wheel, mounting the alternator on the inside of the inner rim and using the outside rim for the fly wheel effect required. This combination increases considerably the capacity of the machine.

As all of the vital parts are inside, it is claimed that this rotor construction does not require such careful handling as the old type and the rotor may be rolled on the floor without, in any way, damaging the poles or squirrel cage windings. As constructed, the new machines form a part of the compressor unit. It is shipped ready to run and no motor foundation or erecting work is necessary.

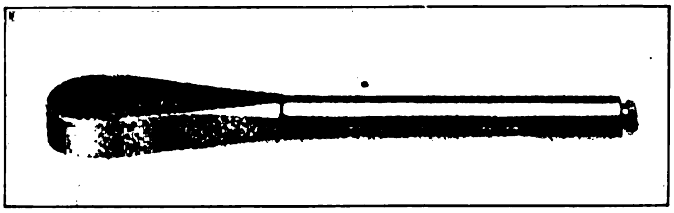
The machine can be used in small locomotive and car shops and around engine terminals where large air compressors are not available. It can be used in case of an emergency as no permanent foundation is necessary.



Reduced voltage starter for high speed synchronous motor

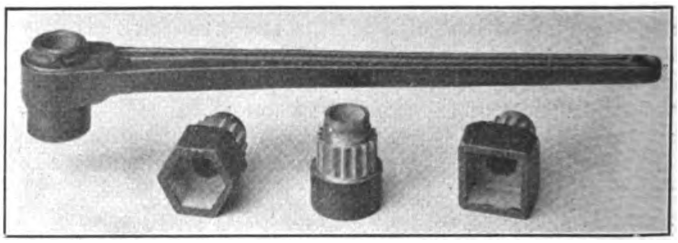
Lowell reversible ratchet wrenches

THE Lowell reversible ratchet wrench is made in seven different standard patterns with three to seven different sizes and various lengths of handles. It has a capacity range in these different patterns and sizes of from ½ in. to 5 in. across the flats in either hexagonal or square shapes.



Lowell No. 1916 pattern reversible wrench

The wrench is reversible in action, a simple movement of the hand adjusting the ratchet to cause it to operate either as a right or left hand tool. The fact that a ratchet wrench, when once engaged with the part which is to be turned, does not have to be removed until the turning operation is completed, results in speedy operation, whether it is used in the open, or in a place difficult of access.



Steel socket reversible wrench

Wrenches of this type can be used to advantage in locomotive repair shops where it is difficult to use a jaw or closed type of wrench. It can also be used in the car department, by the machine tool repairmen or in fact any place where wrenches are a necessity.

These wrenches are manufactured by the Lowell Wrench Company, 54 Commercial St., Worcester, Mass.

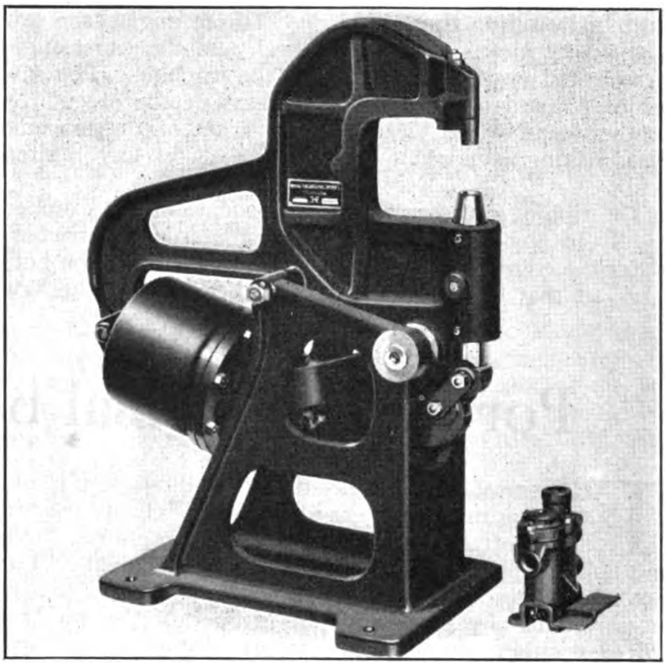
Hanna rapid riveter

THE new Hanna rapid riveter, manufactured by the Hanna Engineering Works, Chicago, Ill., which permits inserting rivets from above and driving from below is shown in the illustration. This feature and a speed of 50 strokes per minute has made possible some unusual riveting records with this rapid riveting equipment.

This machine can be used for certain classes of work in the boiler shop as well as in the passenger and freight car departments.

The mechanism is a combination of simple lever and toggle which combines a long die stroke with a wide range of uniform pressure, thus eliminating the necessity of screw adjustment on the die. The die travel is very rapid as the die approaches the work. The die or plunger speed gradually decreases until it enters the uniform pressure area of the stroke—hence the pressure is uniform. The advantage of this die stroke is, where the work is lightest, the speed is greatest; as the rivet head forms, the pressure increases, reaches a maximum and maintains it for several inches of piston travel. Ordinary variations in rivet lengths and plate thicknesses are automatically taken care of by the wide range of uniform pressure.

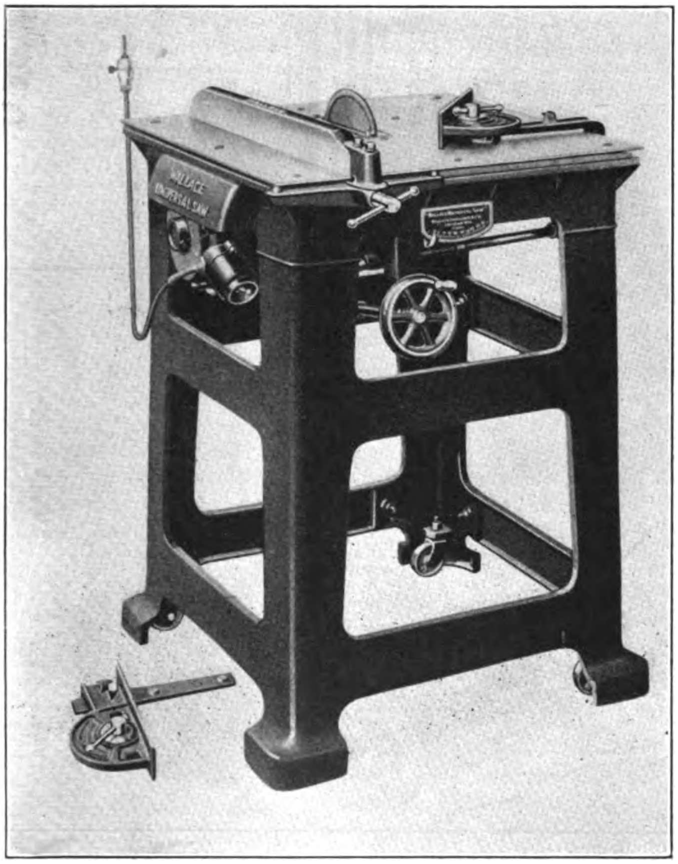
The machine is made in sizes capable of driving 1/4-in. to 1/2-in. rivets hot and 3/16-in. to 3/8-in. rivets cold. It can also be used for punching.



Rivets are inserted from above and driven from below

Large portable universal wood saw

THE accompanying illustration shows the new and larger Wallace portable universal wood saw manufactured by J. D. Wallace & Company, 158 South California avenue, Chicago. The one-way castors make it easy to move from one department of the shop to another and yet it is rigid in operation. The motor and all working parts are built into the upper portion with the table and fences, thus the top part is a complete self-contained bench type saw when lifted off the regular stand. When it is desired to take the saw out on a job and it is not convenient to take the regular cast iron stand, the saw can be taken without its base and placed on any substantial wood stand.



Wallace No. 9 portable universal saw, left side view

The No. 8 machine, equipped with a 1-hp., three-phase motor has ample cutting capacity with precision accuracy; angle cutting, either rip or cross cut; large size table with a capacity of 12 in. by 2 1/4 in. between the blade and fence.

A constant speed air-cooled motor is directly geared to the saw spindle, thus eliminating all belts and their attendant troubles. Ball bearings on the motor are provided with an adjustment for taking up any play. The saw spindle bearings and gears are automatically lubricated by a splash oil system.

The motor operates on either an electric light or power circuit. It is started and stopped by means of a toggle switch located on the motor itself. The toggle is protected by a cap-shaped cup which prevents accidental starting of the motor by brushing against the toggle.

The table is one piece of finished steel, 25 in. by 25 in., fitted with a removable throat piece so that special saws, dado and cope heads requiring a wider throat opening may be used. This machine is designed to handle the smallest and most delicate work with accuracy and yet is powerful enough rapidly to cut stock 2 1/4 in. thick. Utilizing the various adjustments, it is also capable of cutting compound miters, grooves 7/8 in. wide and 1 in. deep, moldings, groove and tongue, etc., by means of a special dado head.

To cut various angles, the saw is tilted instead of the

table, thus the operator is always working on a table that remains in a horizontal position. It is possible to cut at any angle up to 45 deg., while either ripping or cross cutting, by tilting the saw blade. To cut angles, the saw is tilted by means of a hand wheel, and the exact angle is indicated on a dial in front of the machine. The saw blade is raised or lowered for various depths of cuts by another hand wheel located in the front of the machine thus making it possible to cut grooves to any desired depth.

The ripping fence resembles a T-square and is clamped rigidly in any position to a rail at the front of machine under the edge of the table. The fence is ground on both faces so that it can be used on either side of the saw blade. It can be removed from the table when not in use.

Two-cross cut fences are provided so that right or left-hand mitering up to 50 deg. can be done. The angle is indicated on a degree plate located on each fence. Provision is made for taking up any play, thus assuring accuracy. These fences slide on rails on each side of the machine under the edge of the table where they will not become clogged with sawdust, rosin or pitch and where they will not interfere with the quick adjustment of the rip fence. Both fences can be removed when not in use. The saw blade above the table is protected by the Wallace shutter saw guard which acts automatically in protecting the running saw blade. The saw below the table is protected by a fixed cage guard.

Portable universal boiler and fire box drill

THE portable electrically driven drilling, boring and tapping machine, here illustrated, is chiefly used in locomotive and car manufacturing shops, tank and boiler shops as well as locomotive repair shops. The two advantages in using it are that the machine can easily be moved to any place and put in operation in any required position without elaborate preparations for setting up the work, and that it can be employed in places where it is impossible to work with any other drilling machine. It is built by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis. When drilling holes of small and medium diameters the weight of the machine affords sufficient stability. For drilling larger holes or when the head is high on the supporting column the rigidity of the machine is strengthened by four spreaders attached to the base plate.

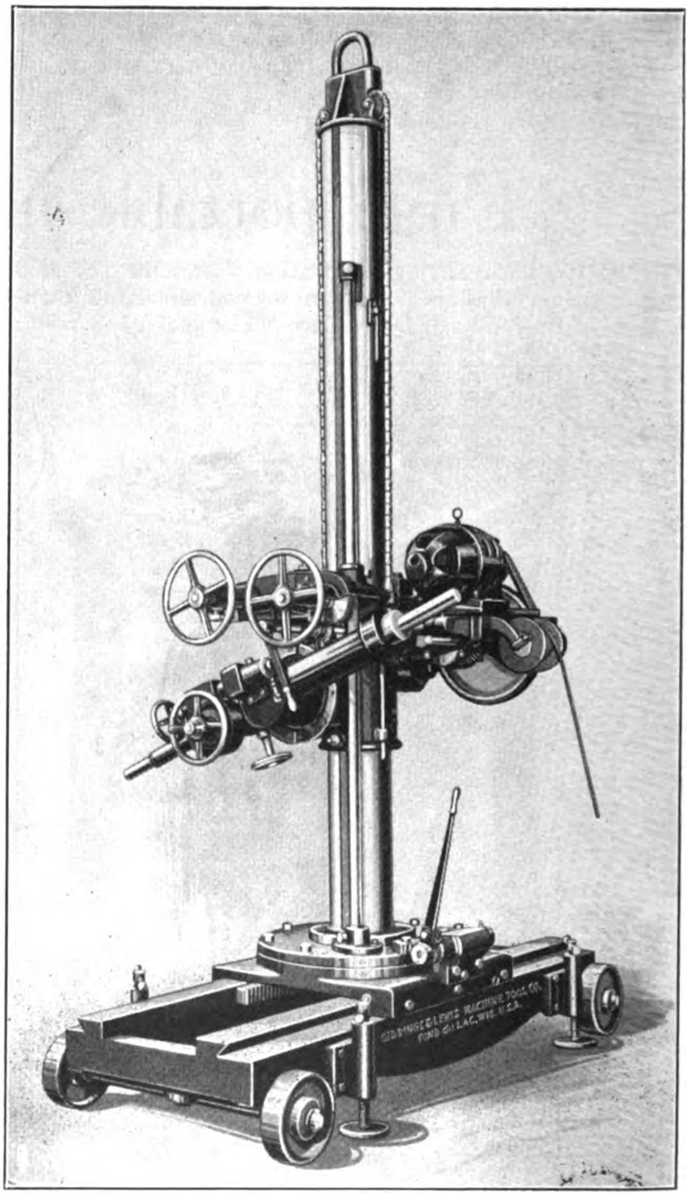
The column is of a heavy tubular section and well braced to withstand all strains. After being machined it is ground to diameter and fully balanced. There is a self-contained drill spindle unit consisting of a heavily ribbed box section, having long guiding ways to insure correct alinement on the column. Power feed is provided for moving the spindle head on the column. The complete spindle unit can be clamped to the column at any desired location. The spindle is made of high-carbon steel and runs in bronze bearings and is liberally supplied with oiling facilities. A friction clutch is provided to reverse the spindle for tapping. Furthermore, a segment on the spindle head permits the setting of the drill spindle at an angle of 30 deg. from the center line of the column in both directions. The complete spindle unit is properly counterbalanced through the chain, sheave and counterweight, the latter sliding in the column.

The driving motor is mounted on the spindle head and the power is transmitted to the speed box through a pinion gear. A winding reel with 30 ft. of cable is furnished with the machine for connecting with available current.

The speed and feed box is a self-contained unit. The levers for changing the speed and feed are easily accessible and within the reach of the operator at all times. The gears run in heavy oil and are enclosed by the speed case proper, the cover of which is easily removed for inspection.

The portable base is of heavy ribbed girder construction and is provided with a planed runway for supporting the platen for the column. A rack and pinion, of liberal size, including a ratchet lever, is furnished for moving the drill on the runway. All of these drills, which are designated as No. 250, are furnished with a segment, worm and ratchet lever to enable a 30 deg. movement of the column in both directions. The controls are centralized.

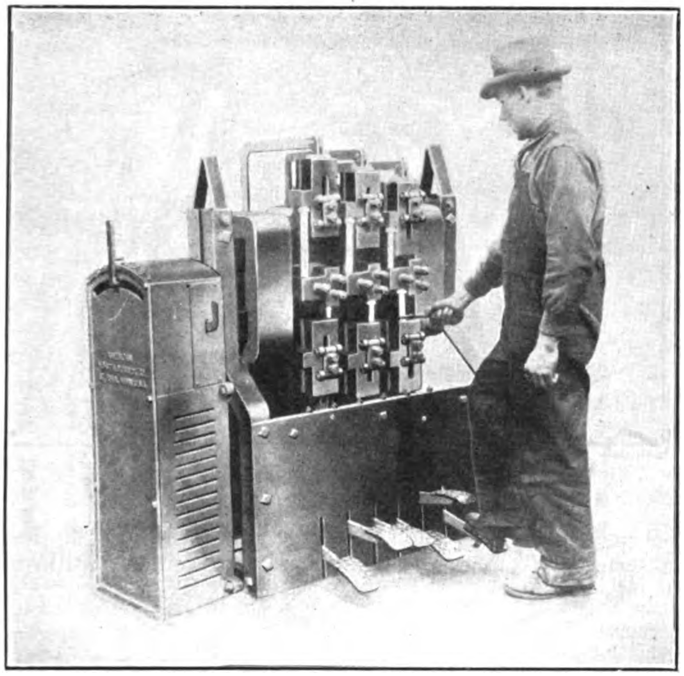
Lubrication of all moving parts has been provided for by a few central oiling points from which the oil is automatically distributed to all parts.



Portable universal boiler and firebox drilling machine mounted on a four-wheel truck

The American electric rivet heaters

THE American Hoist & Derrick Company, St. Paul, Minn., has recently placed on the market electric rivet heaters which are built with an interchangeable center contact block. This enables the operator to unclamp the mid-section and repair any pit marks that



Six rivets can be heated at one time in this American rivet heater

may have developed during several months of constant usage. The pits in this center contact block, as well as in the interchangeable sliding jaws, can then be filled with welded copper which, when cool, is hammered down to add hardness. The contact surfaces of the jaws and center blocks can then be gone over with a file and polished with sand paper.

The heat control is another feature of these heaters. The control instantly regulates the current so that rivets from ¼ in. by ½ in. to 1 in. by 8½ in. can be heated quickly and without burning. This fits these machines for heating nuts, pins, bolts, etc., for tempering. The Models B and BB rivet heaters have been provided with nine steps of heat control; the Models A and AA heaters have been provided with six steps, while the Model C has six steps of control which permit 24 heat combinations to be made. The control is conveniently located at the left of the operator, and the amount of current can be immediately changed by the operator without moving from his position.

Due to the step arrangement, and the uniform contact tension on the heater's sliding jaws, mushrooming of rivets does not occur. These sliding jaws, which are the contact blocks, are manipulated by foot pedals. The jaws slide up and down giving a perfectly square and constant end compression on every rivet, regardless of the length. Another advantage of the sliding jaw design is that it permits a minimum and constant air gap between the secondary "E" elements and the laminated iron core, their source of power. This is the main cause of the high power factor obtained. The sliding jaws, previously mentioned, permit these "E" elements to be constructed of solid cast copper in such a manner as to hug the laminated iron core on three sides. These elements with their sliding contact blocks or jaws are made so they have thirty times the current carrying capacity of a one-inch rivet.

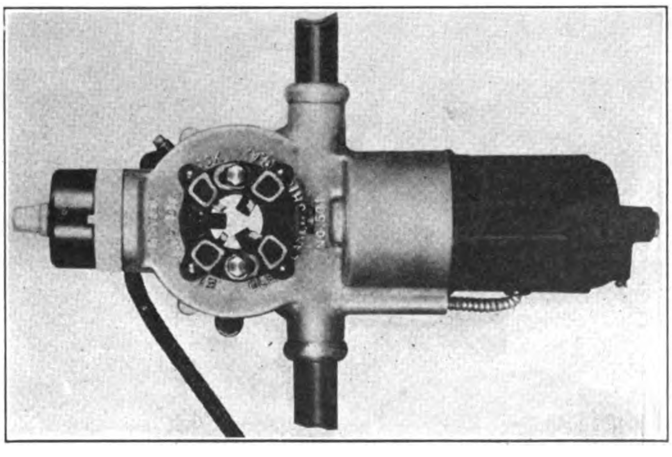
The transformer has been placed close to the field of action and within a few inches of the rivets to be heated, thus eliminating the necessity of conducting the secondary current by cable.

Electrically operated die stock

AN electrically operated die stock for threading ⅜-in., ½-in. and ¼-in. pipe has been developed by the Oster Manufacturing Company, Cleveland, Ohio. Referring to the illustration, the die head is actuated by a fully inclosed universal motor which can be operated from any lamp socket with either d.c. or a.c. current of 110 volts, and in any cycle between 25 and 60, inclusive. The gear reduction from the motor to the die head is enclosed in a housing of aluminum alloy which reduces the weight to less than 35 lb.

The tool is placed on the end of a stationary length of pipe in exactly the same manner as though the operator were threading the pipe by hand. It is centered by means of a universal chuck instead of loose bushings which gives the proper alinement and also eliminates filing burrs off the thread. A separate die head is furnished for each size of pipe. The dies are changed from one size to another by removing a pawl which holds the die head to the rotating sleeve.

The switch for starting and stopping the universal motor is located at the top of the tool where it is conveniently reached by the operator. A quarter turn of this switch rotates the die head, another quarter turn stops the motor and a further quarter turn reverses the motor for backing the dies off the thread.



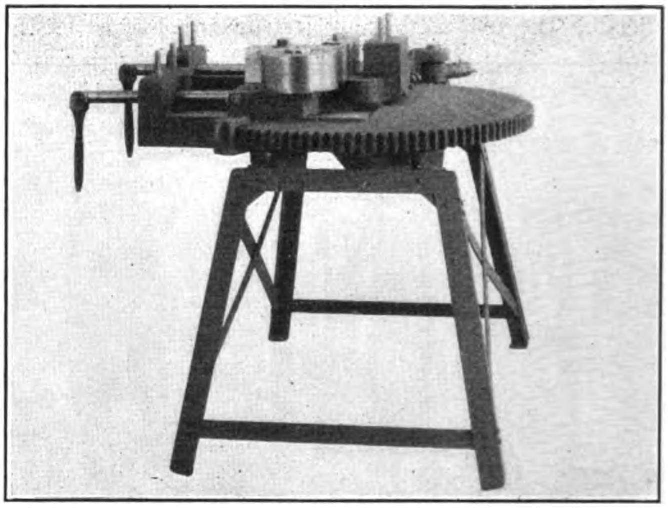
Electrically operated die stock for threading small pipe

Wallace No. 9 hand operated bending machine

THE No. 9 hand operated bending machine manufactured by the Wallace Supplies Manufacturing Company, 1312 Diversey parkway, Chicago, is designed for making sharp corner bends of 90 deg. or less and radius bends of 180 deg. or less, in flat, round or square bars and in pipes and conduits, thus covering a wide range of this class of work usually found in most railroad shops.

The pressure rolls and also the eccentric clamping device for holding the stock, to prevent slippage in the process of bending, are mounted on movable blocks fitted into tapered slides. Each block is operated by means of a large screw to permit of quick adjustment to suit the various sizes of forms as well as the different thicknesses of materials. Bolts are no longer required for clamping these parts to the machine, and the setting up of the dies or forms for various kinds of materials is, therefore, accomplished with comparative ease and rapidity. The tapered slides are of sufficient strength to withstand the pressure and strain of bending the maximum sizes of materials for which this machine is rated to handle in the repair shop.

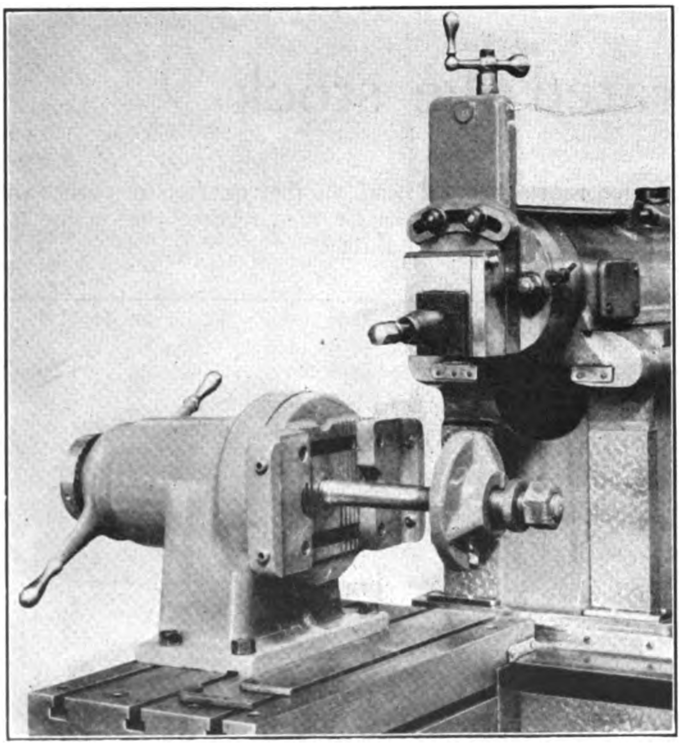
When bending material cold, the machine will handle ¾-in. by 4-in. flat stock, 1½-in. round, 1¼-in. square and 1¼-in. square twisted or less. When bending hot material, the machine will handle 1 in. by 4 in. flat, 1¾ in. round, 1½ in. square, and 1½ in. twisted or less. For bending ⅞ in. round or square bars or anything smaller, the ratchet handle may be thrown out of engagement and the direct lever used. A rod or pipe about 4 ft. long is then inserted in the socket provided for this purpose. In service an auxiliary ratchet lever operates a pinion against a series of teeth in the frame at a large enough ratio to handle the work.



Wallace No. 9 hand operated bending machine

Rod brass fixture for railroad shaper

THE Cincinnati Shaper Company, Elam street and Garrard avenue, Cincinnati, Ohio, has developed a rod brass fixture for its railroad shaper, the use of which makes it more convenient for the operator to index a fixture than to change or reset the tool after finishing one side of the rod brass. In using this fixture it is intended that the tool will be set for finishing down the inside of the flanges, and after one side of the rod brass has been finished, it is only necessary to raise the tool vertically.



Fixture designed for facilitating the finishing of rod brasses

The fixture is indexed for finishing the adjacent side without changing the setting of the tool and this operation is repeated until all four sides are completed. This system of indexing insures the inside faces of the four adjacent flanges being in the same plane and that all faces have an equal bearing all around on the side of the connecting rod solid end.

Referring to the illustration, the fixture is indexed by moving the hand lever to the left, which unclamps and automatically rotates the work. Moving this lever to the right, clamps the work in the fixture. The brass is held by a clamp bolt provided with floating washers. Adjustable chuck jaws hold the two halves of the rod brass against any tendency to open under pressure of clamping or under the cut, thus reducing to a minimum the possibility of spoilt work.

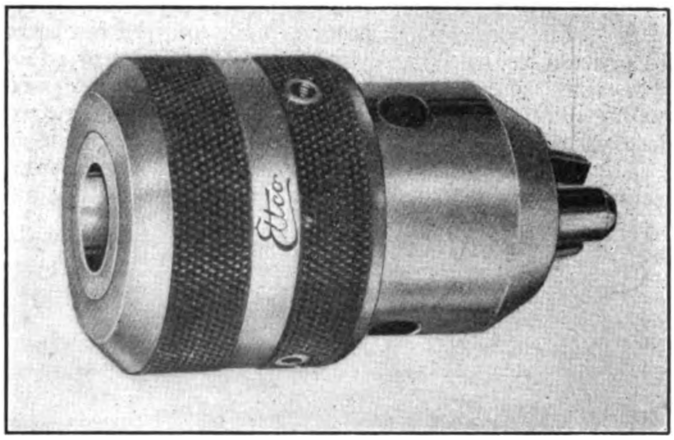
The fixture is of rigid construction and the design of the work holding device is sufficiently heavy so that it is not necessary to use any outer supports, shims or wedges under the outer edge of the brasses being machined. The fixture is, however, so designed that the work overhangs the table sufficiently to permit them to be used. This fixture will handle brasses from 11 in. up to 15 in. over the flange thus making it possible to handle a majority of the brass usually repaired in the average locomotive machine shop.

A keyless self-tightening drill chuck

THE feature of the new Ettco keyless self-tightening drill chuck, manufactured by the Eastern Tube & Tool Company, Inc., Brooklyn, N. Y., is that it has a continuous grip. The chuck does not depend on the operator to tighten it sufficiently to hold the drill, as it is only necessary to close the chuck by hand; the chuck then takes its grip after the work has been started.

As the drill point goes deeper, the load on the chuck increases with a corresponding increase of the grip. No matter how tight the chuck grips, it can be released by hand.

The chuck is self centering, keyless and provided with ball bearings. It is manufactured in four sizes which will hold any size drill from the smallest up to and including ⅝ in. It is particularly recommended for use with electric drills.

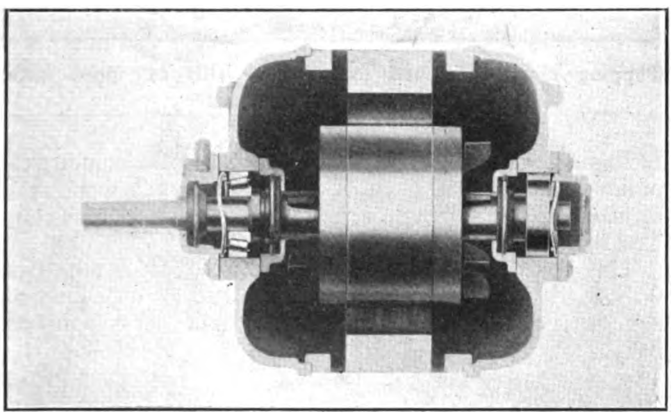


Keyless continuous grip drill chuck for electric motors

Automatic rotor recentering bearings for motors

IT has been stated by many practical operating men of electric motors that 95 per cent of motor troubles may be traced to bearing failure. Many of these troubles are the result of bearing wear so as to allow the rotor to rub on the stator.

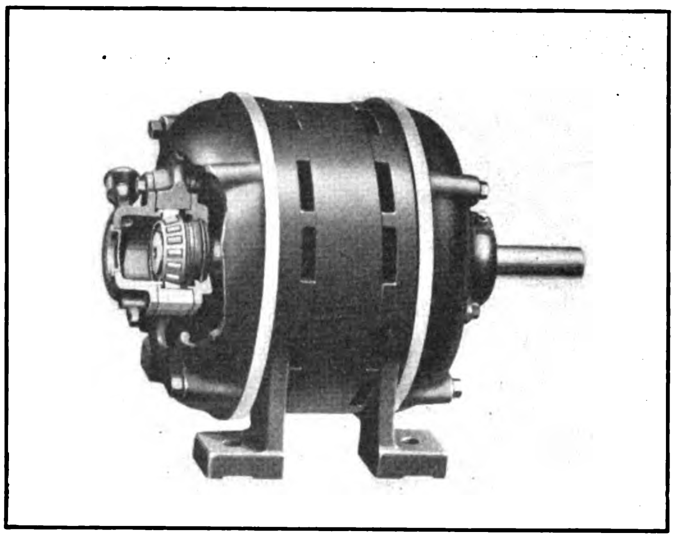
In order to insure a continuous uniform air gap in motors, the Howell Electric Motor Company, Howell, Mich., has developed a complete line of motors with anti-friction bearing, in which any looseness in the bearing, caused by wear or otherwise, is instantly and automatically taken up, so as to keep the rotor of the motor continually centered with a uniform air gap. This is accomplished by the use of a Timken tapered roller bearing, shimmed with a fluted wire spring which acts as a compression spring. The inner race or cone of the Timken bearing is fitted on the shaft with a light press fit. The outer race or cup is fitted into the housing of the motor end bell with a sucking fit which allows creeping of the outer race. The spring is held tight against this outer cup by the outer grease cap, pushing the cup tightly against the rollers and keeping the bearings tight at all times.



Cross-sectional view, showing the bearing arrangement in the Howell motors

This type of bearing in each end of the motor keeps the rotor automatically centered at all times, and the spring allows for any lateral expansion of the shaft which might occur due to heat. Timken tapered roller bearings of nickel-molybdenum alloy steel are used throughout. With this method of spring adjustment, these bearings are expected to last the life of the motor if properly lubricated.

These bearings are arranged for grease lubrication and effective seals are used to keep the grease in and to keep out dust, dirt or abrasives. The motors can be mounted in any position without changing the end bells. They will operate in any vertical position as well as horizontally, as the bearings have a thrust capacity equal to their radial capacity.



This motor is equipped with Timken nickel molybdenum roller bearings

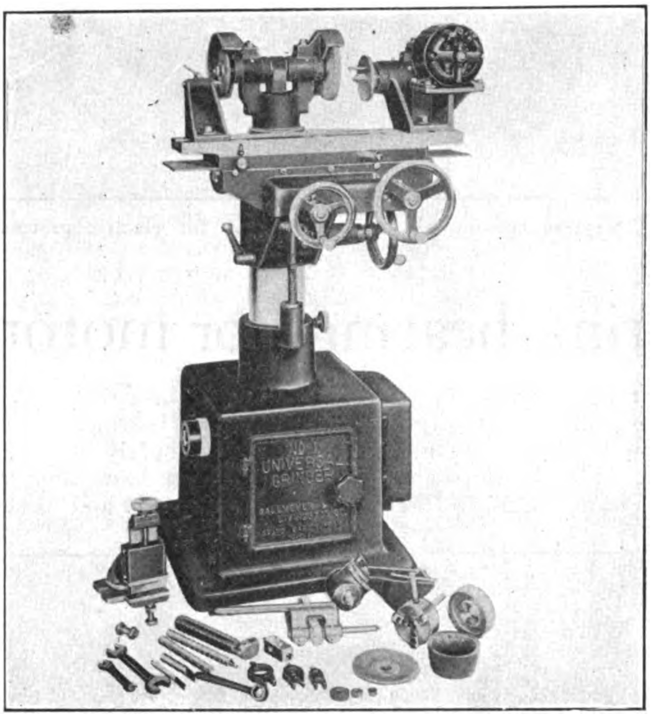
Redesigned universal cutter and tool grinder

THE No. 1 universal cutter and tool grinder manufactured by the Gallmeyer & Livingston Company, Grand Rapids, Mich., has been redesigned to provide for a self-contained motor drive, thus eliminating overhead obstructions. The machine is equipped with a ¾-hp.

motor mounted in the base and bolted through the column to the grinding wheel spindle. A swing door on the base makes the motor easily accessible when it is necessary to make bearing adjustments, clean the commutator, etc.

A ½-hp. lamp socket motor is built into the headstock to provide for handling cylindrical and internal grinding The work spindle is driven by means of a worm, providing the necessary slow speed and eliminating the overhead drum.

Longitudinal, transverse and vertical movements are controlled by conveniently placed hand wheels. The ma-



Motor-driven universal cutter and tool grinder

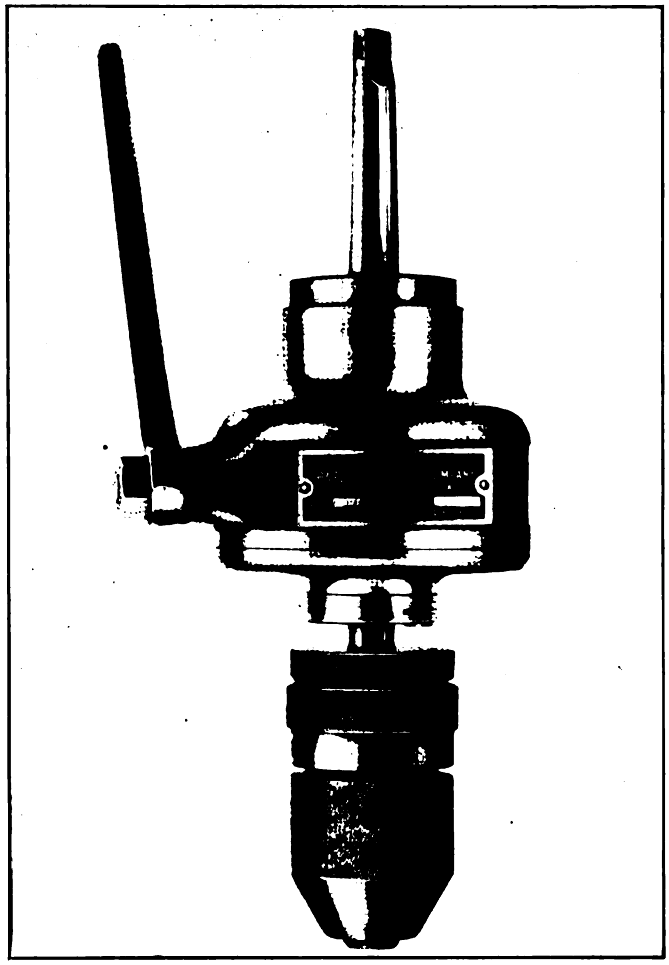
chine swings 9½ in. in diameter up to 20 in. wide. A vertical longitudinal and transverse movement of 6¾ in., 15 in. and 7 in., respectively, is provided. It has a capacity of 12 in. for face milling cutters. The net weight is 585 lb.

Friction-drive reversing tapping chuck

THE Barber-Colman Company, Rockford, Ill., has recently placed on the market a friction drive reversing tapping chuck. This device is known as the John reversing tapping chuck and is designed to convert drills or speed lathes into tapping machines. It drives a tap direct from the spindle through an internal clutch and friction driver member. The friction drive can be adjusted to drive small taps without forcing them to the breaking point, or it can be set to act as a nearly positive drive for the heavier taps.

The tap is fed into the work and automatically reversed by the lowering and raising of the drill press spindle. The reversing speed is twice that of the forward speed. The entire driving mechanism is balanced and concentric with its spindle. The unit is inclosed in an oil-tight case, permitting all gears and moving parts to run in heavy oil or light grease. A hold rod is bolted to the case to prevent the body of the chuck and the plate carrying the reversing idler pinion from rotating. The rod can be used whether the chuck is fitted on to a drill press or on to a speed lathe.

The jaws of the chuck are loosely keyed together with a keeper plate, but are free to slide in the drive shank. The inner ends of the jaws are beveled, and as the closing nut forces the jaws to grip the tap, the jaws accommodate themselves to the square of the tap shank. The metal parts in the tap-holding and friction-drive unit are made



Tapping chuck designed to convert drills or speed lathes into tapping machines

from steel and are heat-treated, as are also the center gear, pinions and clutch members. The internal gear is of bronze. The bearings are bushed and are renewable. The inclosing case is made of cast iron.

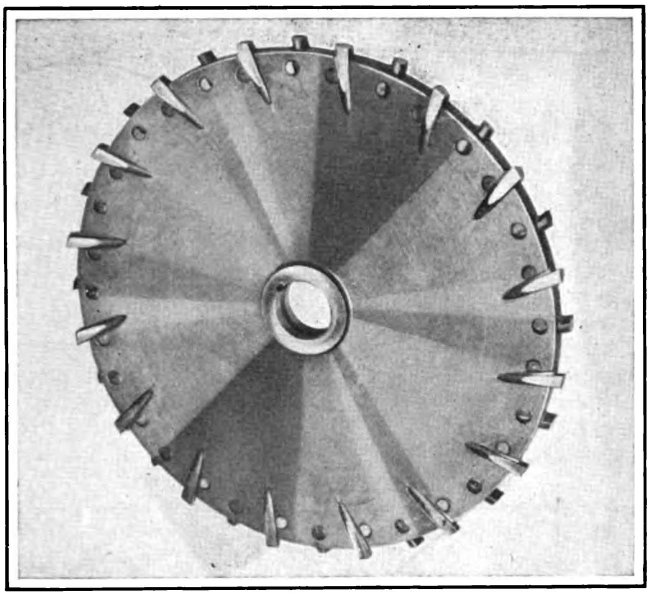
The chucks are made in two sizes: No. 1 for taps from 0 to ⅜ in., and No. 2 for taps from 0 to ⅝ in. They are equipped with Morse Nos. 2 and 3 taper shanks, respectively.

An alloy steel for dies

A STEEL known by the brand name "Crocar" has recently been developed and introduced by the Vanadium Alloys Steel Company, Latrobe, Pa. Crocar is essentially a high carbon, high chromium steel but also contains other alloys. It is unique among tool steels because of its high wearing or non-abrasive qualities and is adapted for a wide range of tools and dies. It does not make a good cutting tool because it does not have the property of red hardness, but is used principally for blanking and forming dies, drawing dies, roller threading dies, plug and ring gages, punches, etc.

Lovejoy deep slotting cutter

A CUTTER for use in machining slots varying in width from ⅝ in. to 1⅛ in. and in cutter diameters above 6½ in., has recently been placed on the market by the Lovejoy Tool Company, Inc., Springfield, Vt. The

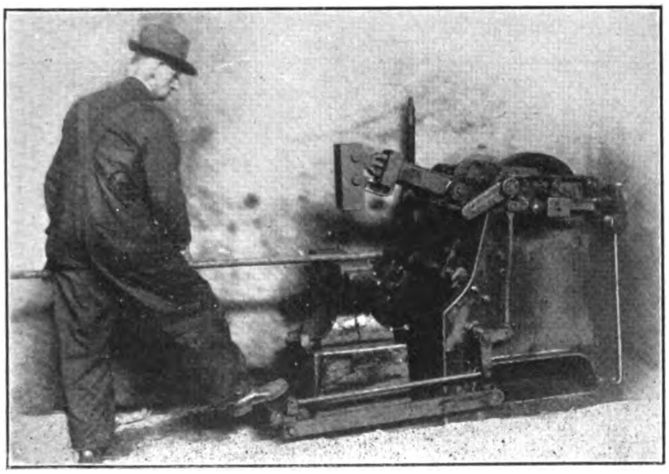


Lovejoy Type F deep slotting cutter

blades are positively locked and have a slight side clearance. The angle at which the blades are set in the cutter center is dependent on the width of the slot which is to be cut. Each insert has a liberal length allowance.

Chambersburg blacksmith hammer

A BLACKSMITHS' hammer designed to serve as an auxiliary to practically all forging operation in blacksmith and forging shops, has recently been placed



The head of this hammer weighs 50 lb. and strikes at a maximum rate of 218 blows per minute

on the market by the Chambersburg Engineering Company, Chambersburg, Pa. This hammer is, in reality, a mechanical "sledge man," capable of any intensity of blow from a tap to one far beyond human possibilities. The hammer head is so suspended that its face is always parallel to the anvil.

A power traverse, operative from the treadle which controls the blow, permits work on any part of the anvil face.

The hammer head weighs 50 lb. and strikes at a maximum rate of 218 blows per minute. A 2½-hp. motor, mounted on the frame, is required to drive the hammer, or power can be transmitted from a line shaft.

Steel equipment for the toolroom

THE Lyon Metallic Manufacturing Company, Aurora, Ill., has developed a line of standard steel toolroom equipment which is built in individual sections, like that shown in Fig. 1. All sections are 7 ft. high, 3 ft. wide, by 1½ ft. deep. The shelves are adjustable on 1½-in. centers and the crosswise dividers are adjustable on 1-in. centers. These sections may be equipped with standard upright shelving, having either common or divided backs, or with sloping shelves for single or double-face racks. Provision is also made in the design of the shelving for the installation of check hooks.

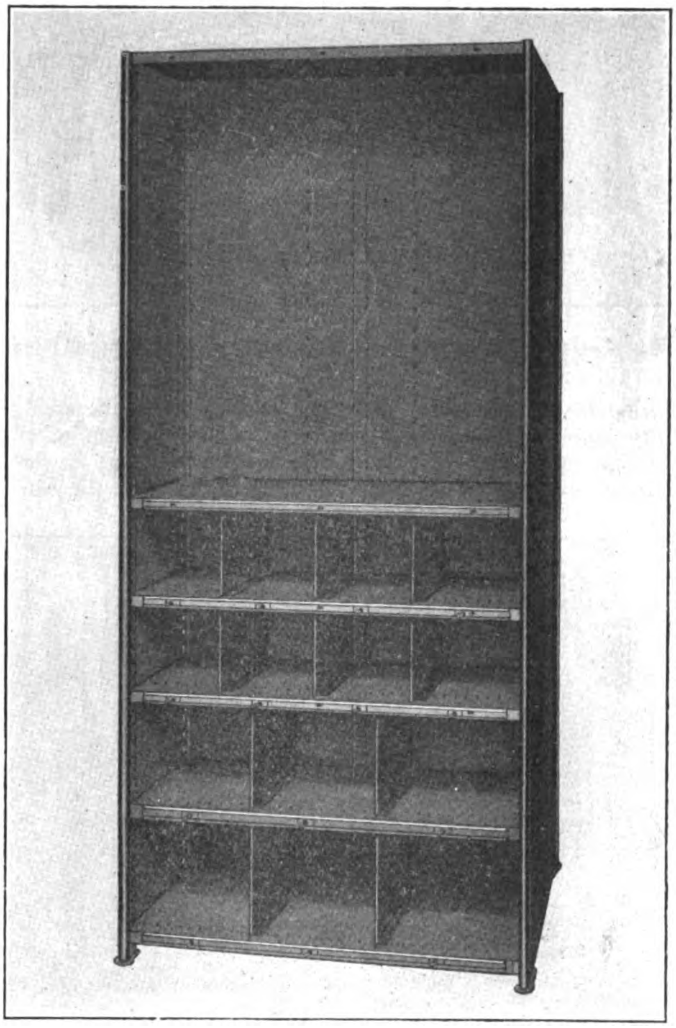


Fig. 1—Section of the Lyon steel tool room equipment

Lyon steel toolroom equipment can be adapted for the storage of all types of tools usually kept in a toolroom. Figs. 2 and 3 show two types of inserts which can be placed in the top part of the section shown in Fig. 1. Fig. 2 is designed to provide space for small, as well as

large tools. The shelving dividers are placed on 2-15/16-in. centers, providing a total of 108 compartments. Fig. 3 shows an insert for holding milling cutters which are hung on pegs on 1-in. centers. The milling cutter insert consists of one stationary panel, 38 in. by 36 in., and two

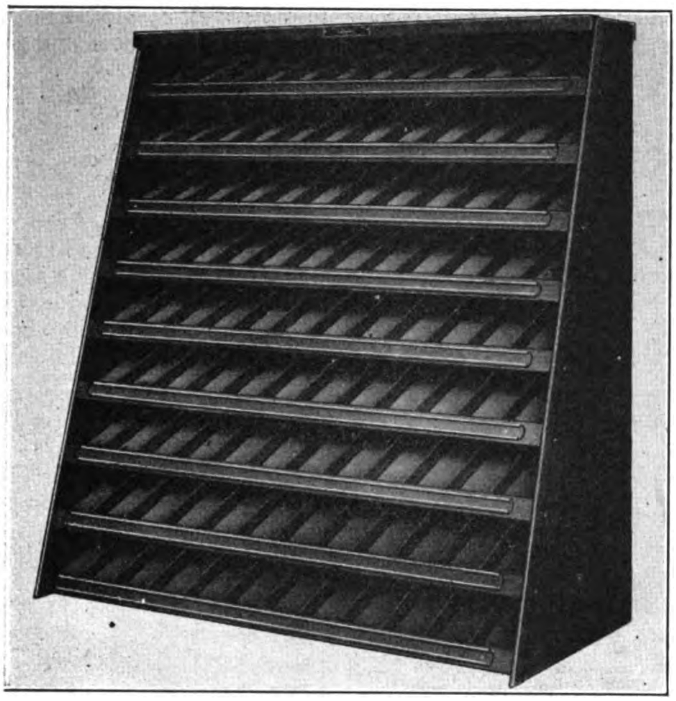


Fig. 2—Insert equipped with sloping shelves for small tools

swinging panels, 38 in. by 18 in. Both sides of the swinging panels may be used if desired. The portion of the section shown in Fig. 1, underneath the insert may be used for other types of shelving than that shown in the illus-

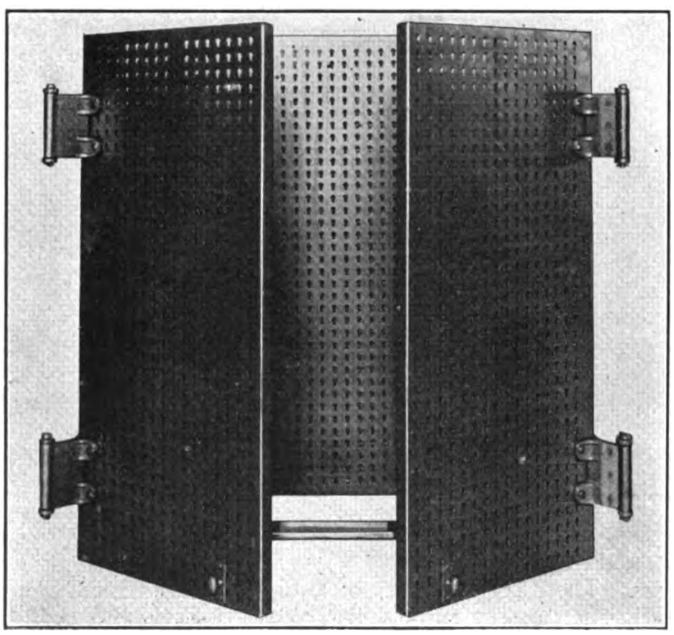
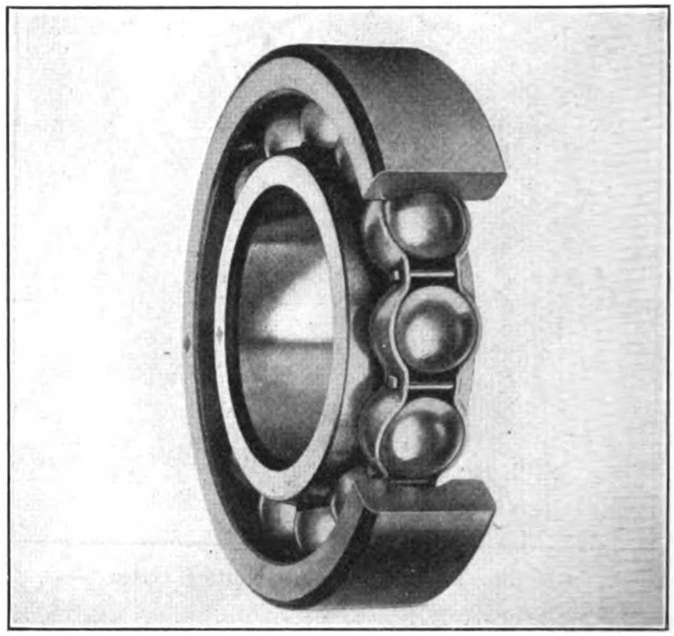


Fig. 3—Milling cutter insert—Fits in the top compartment of the section shown in Fig. 1

tration. This type of steel toolroom equipment requires a space 36⅞ in. wide by 18 in. deep, for each section of rack. It can be adapted to any toolroom layout and for handling all kinds of tools and shop fixtures.

Balls in "SRB" bearings forged from molybdenum steel

THE "SRB" annular ball bearing, single and double row, made by Standard Steel & Bearings, Inc., Plainville, Conn., is now equipped with balls forged from

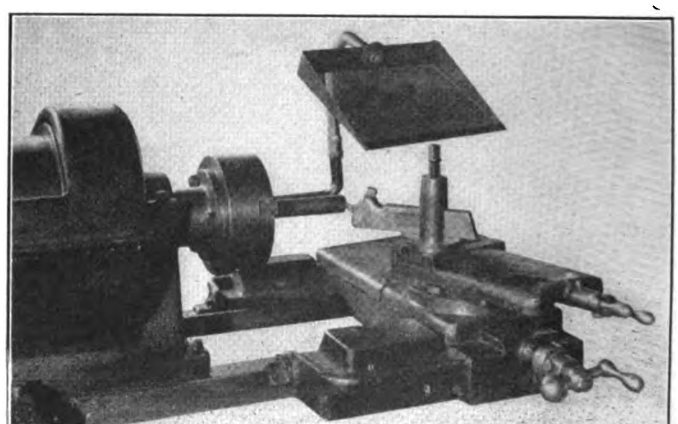


SRB single row bearing provided with molybdenum steel balls

molybdenum steel, which has been selected to secure greater toughness, hardness, loading carrying capacity and durability.

Acme eye shield for machine tools

THE Chicago Eye Shield Company, 2300 Warren avenue, Chicago, have placed on the market the Acme eye shield for use on such machines as grinders, buffers, saws, spot welders, lathes, planers, etc.



The Acme eye shield in position on a lathe

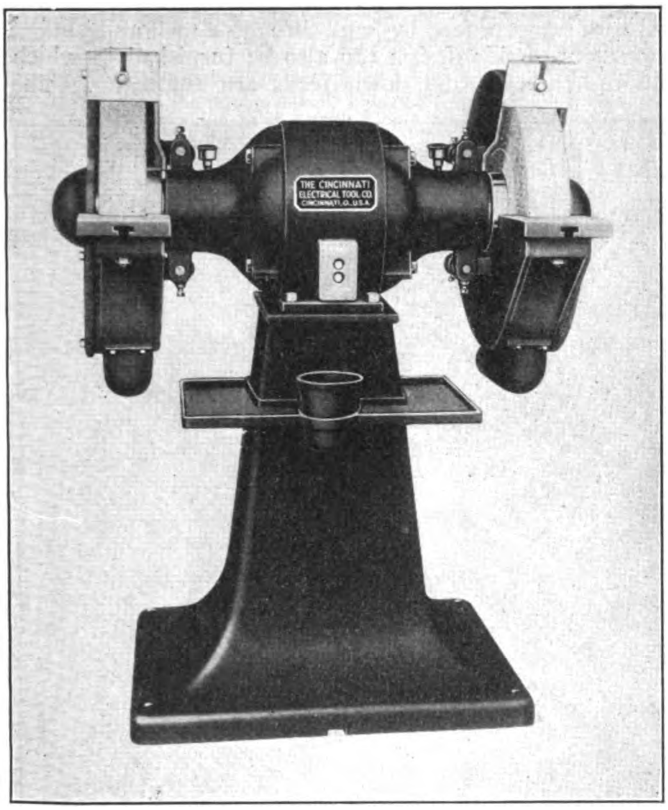
The glass is of the non-shatterable type which is not easily broken and will not scatter when broken by an unusually hard blow. The 7-in. by 4-in. glass protects the head and face of the workman.

The shield is furnished complete with adjustable steel brackets, pipe, lock nuts, wall brackets, an 18-in. flexible arm steel frame and glass. The flexible arm permits instant adjustment by hand without tools, to any desired position.

One shield can be used to cover both wheels of a double grinder, but where both wheels are in constant use, it is advisable to equip the machine with one shield for each wheel.

Heavy duty double end floor grinder

THE Cincinnati Electrical Tool Company, Cincinnati, Ohio, has recently added two new floor grinders to its line of portable electric tools. These new machines are respectively 2-hp. and 3-hp. fully enclosed heavy duty floor grinders. The steel spindles are turned and ground, and mounted in ball bearings which are enclosed in dust-proof housings. The bearings are locked to the spindles so as to provide end thrust and to minimize shaft wear. The wheel flanges and nuts are finished all over to provide proper spindle balance. The wheel guards are adjustable to the wear of the grinding wheels and are equipped with exhaust outlets. Removable covers bolted to the guard completely enclose the sides of the grinding wheels and the ends of the spindle.



The motor and ball bearings of this grinder are enclosed in a dust-proof housing

The 2-hp. grinder is equipped to carry 12-in. by 2 in. by 1¼-in. grinding wheels and the 3-hp. grinder will carry 14-in. by 2½-in. by 1¼-in. grinding wheels. The electrical equipment is adaptable to either alternating current of 220 volts or 440 volts, 25 to 60 cycles, two or three phase; or direct current of 115 or 230 volts.

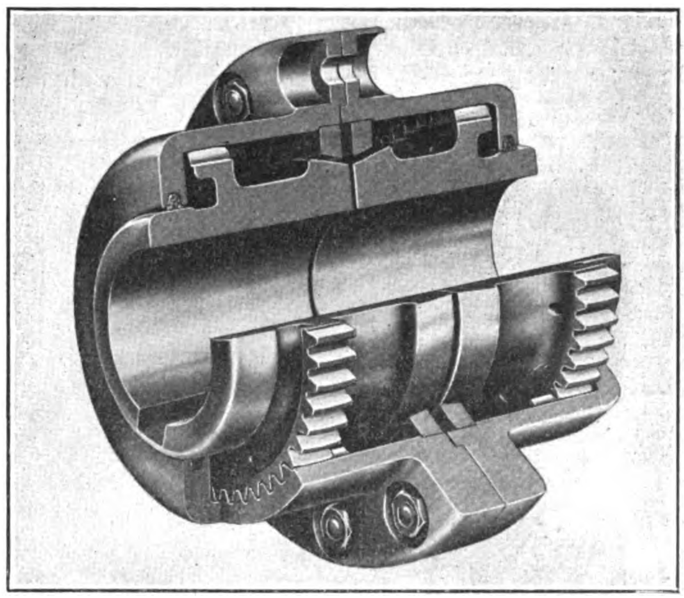
Lacerda countersinking frame

A COUNTERSINKING frame manufactured by the Lovejoy Tool Works, 319 West Ohio street, Chicago, is designed for countersinking rivet holes on the inside flanges of boiler sheets. Any flat air-motor is fitted with this yoke which extends over and outside of the flange. A feed screw with a swivel head passes through this yoke and is directed against the outside of the flange directly opposite the drill point. Pressure applied to the screw feeds the countersink to the required depth. It is said that one man can countersink one hole per minute.

Countersinking frame for use with flat air motors

The Poole flexible coupling

THE Poole flexible coupling, manufactured by the Poole Engineering & Machine Company, Baltimore, Md., consists of six parts: two hubs having an external gear on each, meshing with internal gears in two sleeves which are bolted together, and two alining rings which are fitted in the two sleeves.

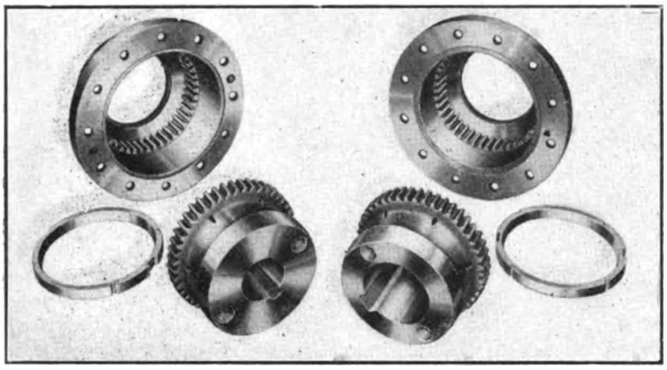


A sectional view of the Poole flexible coupling

The outer faces of the teeth on the hubs are formed spherically which provides a true self alining bearing for the connecting sleeve, so that if the two shafts are out of alinement, the sleeve assumes a neutral position with a

perfectly formed and lubricated bearing on the spherical surface of each shaft hub.

The coupling is easy to line up when the coupling and the connecting shafts are being assembled. Each hub of the coupling has a tapered surface which in turn engages with a tapered surface on the interior of each sleeve. When the sleeve is pushed back the sleeve, the hub and shaft act as a single unit and proper alinement can be quickly and accurately made by using a straight edge across the two flanges of the sleeve and calipers or feeler



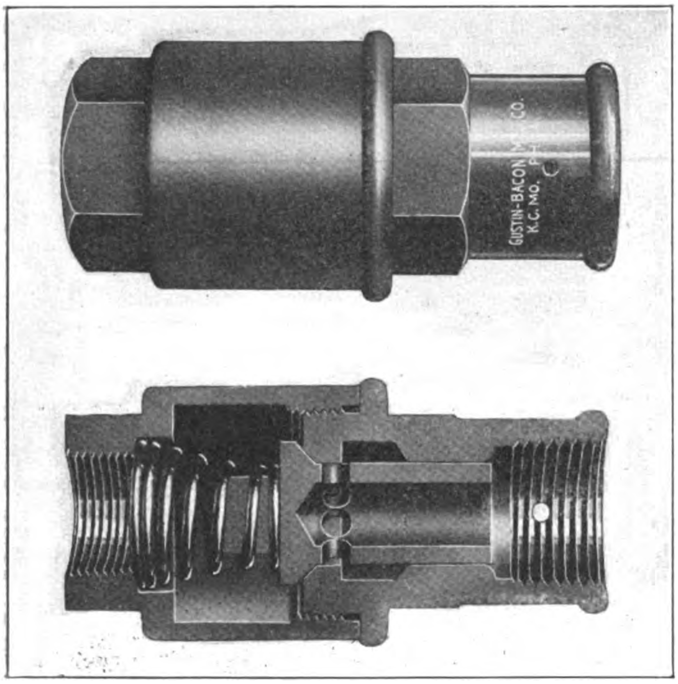
The six parts which make up the flexible coupling

gages between the coupling faces. The sleeves and hub are never out of tooth engagement during alinement.

Oil holes are provided in one side of the coupling flange where oil should be poured in until it runs around the shaft hub. When the coupling is running, the oil spreads out under centrifugal pressure so that the sleeve bearings and gear teeth are entirely submerged in oil, which effectually prevents wear on any contact surfaces, and assures positive lubrication.

An automatic post valve

THE Gustin-Bacon Manufacturing Company, 14-16-18 West Twelfth street, Kansas City, Mo., has placed on the market an automatic post valve, known as the type G-B, for use in connection with the Lowrey hose coupling. A description of the Lowrey hose



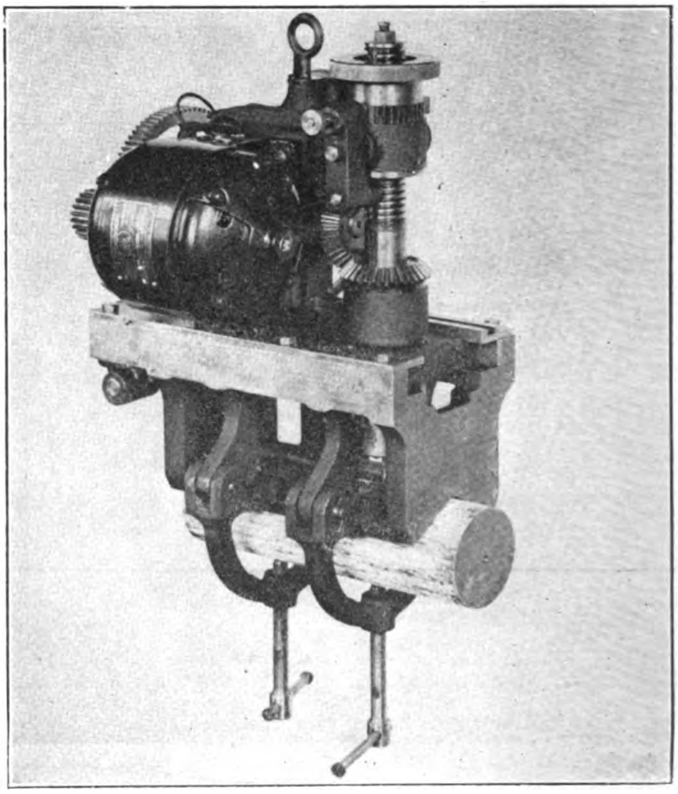
The G-B automatic post valve

coupling was published in the March, 1924, issue of the *Railway Mechanical Engineer*, page 190.

The G-B automatic post valve is so constructed that it automatically opens when the Lowrey coupling is connected to it and automatically closes when the coupling is disconnected. The construction of the valve is shown in the section view of the illustration. The area of the ports is 25 per cent greater than the orifices in the valve, which is considered sufficient to overcome any retarding action due to friction. The vent shown in the outlet end of the valve bleeds off the air in the hose line as the coupling is disconnected. This prevents the hose from whipping and also relieves the strain on the threads of the coupling. Screwing the male portion of the coupling into the automatic post valve pushes the valve off the seat and the valve does not reseat until the coupling is removed. The automatic post valve has no revolving plug to become scored, due to rust and other foreign matter.

Portable shaft keyseat miller

SHOWN in the illustration is a portable shaft keyseater manufactured by John T. Burr & Son, 421 Kent avenue, Brooklyn, N. Y. This keyseater is designed for operation by either electric or air motor. The electric motor-driven machine shown, has an automatic downfeed with traverse feed by hand through a rack and pinion. Keyseaters of this design can also be furnished in which both the traverse and down feeds are automatic. The



A portable shaft keyseater which can be used on shafts or pins up to 11 in. diameter

keyseater is self centering, the work of chucking consisting of placing the machine over the shaft or axle and clamping in position. It is a vertical spindle machine.

These keyseaters are made in various sizes for milling keyways and shafts up to 11 in. in diameter and having traverse feeds up to 12 in. The spindle is provided with a No. 7 B. & S. taper hole and can take standard course tooth end mills, up to 1¼ in. It runs in bronze bushings and the driving miter gears are of steel.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

Fourth car building contest held by D. & H.

On Tuesday, May 18, the car department of the Delaware & Hudson held its fourth car building contest at Green Island, New York. The problem on this occasion was the rebuilding of the trucks, underframes and superstructure of a D. & H. 85,000-lb. capacity drop-bottom gondola. The three teams competing represented the car shops of the Pennsylvania, Susquehanna and Saratoga divisions where work of this character is the usual performance. The Saratoga team, which was declared the winner by the judges, completed the work in 6 hr. 11 min. and was awarded the Birkett memorial cup. The Green Island car shop is situated between Troy, N. Y., and Albany.

Railroad men visit A.R.A. air brake laboratory at Purdue

About 150 men, representing as many Class I railroads, gathered at Purdue University on Wednesday, May 12, to inspect for the first time the air brake testing laboratory and work now being performed at Purdue University in co-operation with the American Railway Association. For the benefit of the visitors a series of five demonstrations was staged, under three different conditions, making fifteen tests in all. H. A. Johnson, director of research at Purdue, explained that no results were available at that time and that none would be summarized for many months, nor would detail information as to how any particular set of equipment functioned be available until the whole work is completed.

Dean A. A. Potter and Prof. G. A. Young, head of the school of mechanical engineering, addressed the guests at luncheon. Dean Potter outlined briefly a history of Purdue and sketched the engineering experiment station work being performed at the institution.

New equipment

During the first three months this year Class 1 railroads installed in service 21,363 freight cars, according to reports with the Car Service Division of the American Railway Association. This was a decrease of 22,790 cars, as compared with the corresponding period last year of 16,289 cars compared with 1924. The total included 9,582 box cars, 9,069 coal cars and 1,206 refrigerator cars.

In March the railroads placed in service 8,546 freight cars, including 3,934 box cars, 3,477 coal cars and 544 refrigerator cars.

Class I railroads on April 1 had 49,524 freight cars on order, an increase of 3,398 compared with last year but a decrease of 19,774 compared with 1924. Of the total 20,846 were box cars, 20,237 coal cars and 6,099 refrigerator cars.

Also 570 locomotives were placed in service during the first quarter 1926 an increase of 140 compared with the first quarter in 1925 but a decrease of 91 locomotives compared with 1924. Class I railroads on April 1 had 738 locomotives on order, compared with 315 on the same date last year and 520 on the same date two years ago.

These include new and leased equipment.

Bureau of Explosives

Colonel B. W. Dunn, chief inspector of the railroads' bureau for the safe transportation of explosives and other dangerous articles, has issued his 18th annual report, which is for the year ending December 31, last. Under the head of explosives proper, the record for the year shows 26 accidents but no persons killed or injured; property loss, $11,702.

Including explosives "and other dangerous articles" the total for 1925 is 1,601 accidents in railway transportation, 13 persons killed, 57 injured; total property loss $1,056,178. Of this total 78 per cent is charged to inflammable liquids, mainly gasoline. Under the head of inflammable liquids the causes are given as: negligence of employees, 23 cases; rough handling, 103 cases; improper loading, etc., 184 cases; derailment or collision, 66 cases; miscellaneous, 322 cases. Ten persons lost their lives and 15 were injured as a result of explosions of gasoline. One-half the deaths and more than one-half of the injuries due to such accidents were the direct consequences of trespassers entering empty tank cars. The 66 train accidents are charged with an aggregate loss, under this head, of $650,847. The aggregate quantity of explosives transported on the railroads of the country during the year (with no death or personal injury) was over 500 million pounds. This record, says Colonel Dunn, affords positive evidence of excellent team work by thousands of factory and railroad employees. The report contains the usual chapters on the results of the studies, experiments and inspections made by the employees of the bureau during the year. M. L. Oglesby, special representative of the bureau, has during the year delivered 193 addresses before meetings which had a total attendance of 16,259. Other lectures have been delivered at 433 places to meetings recording an aggregate attendance of 19,762.

Reprints of bulletins which have been issued by the bureau during the year fill an appendix of 30 pages.

A. R. A. purchases draft gear drop-test machine

The American Railway Association has authorized an appropriation for the purpose of building, installing and housing a drop-test machine for testing draft gears to determine their capacity, absorption of recoil and endurance, and from the information obtained prepare suitable specifications under which the railroads may purchase draft gears that are known to meet the prescribed standards of efficiency. It will also be used to obtain information that will be of assistance in developing draft gears generally. The contract for the machine has been awarded to the Tinius-Olsen Testing Machine Company, Philadelphia, Pa., delivery being called for by November 1, 1926, and arrangements have been made to have it installed in the test department of Purdue University, Lafayette, Ind. The installation of this machine, together with auxiliary apparatus and equipment, will necessitate the construction of a new brick and steel building, 50 ft. by 125 ft. on the Purdue campus. All expenses for the work, which will be about $50,000 this year, will be borne by the American Railway Association. Annual expenditures will range from $10,000 to $15,000 until the tests are completed. The tests are to be conducted by the engineering experiment station of Purdue University and will be under the direct supervision of Dean A. A. Potter, the director.

The drop-test machine will be provided with two falling weights or tups. The larger one will weigh 27,000 lb. and is believed to be heavier than any heretofore used for the purpose, while the smaller one will weigh 9,000 lb., the weight most frequently used in the past. The weights may be readily removed or applied without dismantling the vertical columns.

The machine will be driven electrically, the control equipment being so designed that operation may be manually or automatically controlled, and it will be provided with a chronograph for recording the action of the draft gear or gears being tested throughout the cycle of compression and release.

Meetings and Conventions

Program Mechanical Division convention at Atlantic City

The seventh annual meeting of Division V—Mechanical, American Railway Association, will be held in the Greek Temple on Young's Million Dollar Pier, Atlantic City, N. J., June 9 to 16, inclusive. Following the custom of years, the sessions will be held each day from 9:30 a. m. to 12:30 p. m. (daylight saving time). The first week's program, Wednesday, Thursday and Friday, June 9 to 11, inclusive, is devoted to car subjects, while the second week's program, Monday, Tuesday and Wednesday, June 14 to 16, inclusive, is devoted particularly to motive power subjects. The program is as follows:

Wednesday, June 9

Address by R. H. Aishton, president, American Railway Association
Address to be announced
Address by chairman
Action on minutes of annual meeting of 1925
Appointment of Committees on Subjects, Resolutions, Correspondence, etc.
Unfinished business
New business
Committee reports:
General
Nominations
Design of Shops and Terminals

Thursday, June 10

Committee reports:
Arbitration
Prices for Labor and Materials
Safety Appliances
Specifications and Tests for Materials
Loading Rules

Friday, June 11

Committee reports:
Car Construction
Tank Cars
Brakes and Brake Equipment
Couplers and Draft Gears

Monday, June 14

Report of Committee on Locomotive Design and Construction
Election of Officers
Report of Committee on Wheels

Tuesday, June 15

Committee reports:
Electric Rolling Stock
Locomotive and Car Lighting

Wednesday, June 16

Report of Committee on Utilization of Locomotives
Individual paper—An Analysis of Relative Tracking Characteristics, by H. H. Houston, Westinghouse Electric & Manufacturing Company
Closing exercises

A.S.M.E. to hold spring meeting in San Francisco

Final arrangements have been completed for the spring meeting of the American Society of Mechanical Engineers to be held at San Francisco, June 28 to July 1, 1926. The program includes a number of subjects of interest to railroad men. On Tuesday morning, June 29, there will be papers presented on the Growth of University Extension Training of the Non-College Type for the Industries of the West, and on Education and Training of Apprentices on the Pacific Coast. A joint meeting of the Fuel and Railroad Divisions is scheduled for Wednesday morning, June 30, at which session papers on Combined Oil and Gas-Burning Furnaces for Power Plant Use; Fuel Oil for Railways, and the Development of the Caterpillar Tractor and Its Application to Industry, will be presented. Following is the program of the spring meeting:

Monday, June 28

Morning—Council meeting.
Conference of local sections delegates.
Meeting nominating committee.
Afternoon—Excursion to Muir Woods and alternate excursions. Shopping trips for ladies.
Evening—Reception and dance.

Tuesday, June 29

Morning—Meeting nominating committee.
Simultaneous sessions.
Petroleum—
Fluid Flow in Pipes of Annular Cross-section, by D. H. Atherton.
Mechanical Engineering in Cracking, Heating and Cooling of Oil, by B. N. Broido.
The Termination of Charcoal tests, by F. L. Kallam.
Industrial Training and Education—
The Growth of University Extension Training of the Non-College Type for the Industries of the West, by John L. Kerchen.
Education and Training of Apprentices on the Pacific Coast, by Paul Eliel.
Afternoon—Steamer trip on San Francisco Bay. Ladies' bridge party.

Wednesday, June 30

Morning—Meeting nominating committee.
Simultaneous sessions.
Fuels and Railroad—
Combined Oil and Gas-Burning Furnaces for Power Plant Use, by J. Grady Rollow.
Fuel Oil for Railways, by J. C. Martin, Jr.
The Development of the Caterpillar Tractor and Its Application to Industry, by Pliny E. Holt.
Hydraulic—
Aspects of Steam Power in Relation to a Hydro Supply, by A. H. Markwart.
Water Power and Steam Power in California Utilities, by H. A. Barre.
Speed Changes of Hydraulic Turbines for Sudden Changes of Load, by E. B. Strowger and S. Logan Kerr.
Oil and Gas Power—
Transmission of Power on Oil-Engine Locomotives, by A. I. Lipetz.
Oil Engines as a Drive for Pipe Line Pumps, by F. Thilenius.
Uniform methods of Calculating the Periodic Displacement and Oscillations in Synchronous Machines, by C. W. Cutler.
Afternoon—Auto tour around San Francisco.
Excursions.
Ladies' tea at Fairmount Hotel.
Evening—Banquet.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

Division VI.—Purchase and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Convention September 21, 22 and 23, Hotel Sherman, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting June 7. Paper on What can the car department do to better transportation conditions in the United States, will be presented by D. F. Stephens, general superintendent, B. & O., Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

International Railway Fuel Association.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Texas.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The American Car & Foundry Company has moved its office in New York from 165 Broadway to 30 Church street.

The Cleveland Pneumatic Tool Company has removed its Boston, Mass., office from 60 High street to 142 Berkeley street.

T. O'Malley, president of the O'Malley-Beare Valve Company, Chicago, died in that city on May 14, as the result of a case of acute indigestion.

W. C. Peters has been elected vice-president in charge of engineering and sales of the National Railway Appliance Company, New York. Mr. Peters was born on September 29, 1891, at St. John, New Brunswick, and was educated at the English High School, Worcester, Mass., taking the mechanical engineering course at the Worcester Polytechnic Institute. He entered the employ of the Boston & Albany in June, 1911, as special apprentice in the locomotive shops at West Springfield, and successively held positions of shop draftsman, foreman, safety appliance inspector, and then served from January, 1915, to April, 1920, in the office of the superintendent of motive power and rolling stock at Boston, Mass., as draftsman and assistant mechanical engineer. He enlisted with the 14th Engineers (Light Railway) in June, 1917, going overseas in July, 1917; the regiment first being assigned to the Third British Army North, where it operated on the Somme Front from August, 1917, until after the general British retreat in March, 1918. The regiment then joined the American troops in July in the Chateau-Thierry Sector, subsequently joining in all the future major engagements of the United States Forces. After spending two years overseas Mr. Peters returned as first lieutenant and was discharged in July, 1919. He became associated with the National Railway Appliance Company as manager of the New England department in April, 1920, and since April, 1924, was manager of sales and engineering until his election on April 1 as vice-president in charge of engineering and sales.

W. C. Peters

The Flexo Supply Company, St. Louis, Mo., has removed its office from 104 South Main street to 4459 Manchester avenue, St. Louis, Mo.

The Timken-Detroit Axle Company has removed its New York City office from 2 Rector street to 41 East Forty-second street, New York City.

The Hutchins Car Roofing Company has moved its Chicago office from 310 South Michigan Avenue, to 122 South Michigan Avenue.

F. A. Ogden, Jr., dealer in railway car specialties, has removed his office from 1011 B. F. Jones building to 528 Fourth avenue, Pittsburgh, Pa.

The Railway Materials Company, Chicago, has moved its offices from the Wrigley building to the Old Colony building, 407 South Dearborn street.

John Mulligan, president of the Ulster Iron Works, Dover, N. J., died on May 5 at Clifton Springs Sanatorium, Clifton Springs, N. Y., at the age of 56.

W. C. MacFarlane, vice-president and general manager of the Minneapolis Steel & Machinery Company, Minneapolis, Minn., has been elected president of that company.

John Hulst, assistant to vice-president and chief engineer of the United States Steel Corporation at New York, has been elected a vice-president to succeed John Reis, resigned.

L. R. LeMoine, chairman of the board of the United States Cast Iron Pipe & Foundry Company, Philadelphia, Pa., died on April 23 in Villa Nova, Pa., after a brief illness.

J. H. Larmonth, Montreal, has been elected vice-president and Gordon W. Dunn, Montreal, has been elected vice-president and managing director of the P. & M. Company, Limited.

H. M. Curry, Jr., has been elected president of the Premier Staybolt Company, Pittsburgh, Pa., J. F. McGann has been appointed assistant sales manager and C. B. Woodworth, technical representative.

J. V. Conway, special railroad representative of the Chicago Pneumatic Tool Company, has resigned to become western railroad representative of the Heywood-Wakefield Company, with headquarters at Chicago.

R. L. Cluverius has been appointed southern department manager of the National Railway Appliance Company, with headquarters in the Munsey building, Washington, D. C., succeeding H. W. Kidwell, resigned.

Thomas O'Brien, after a service of 16 years as engineer and sales manager with the John F. Allen Company, New York, has left that company and become associated with the Reliable Machine & Tool Company, New York City, in a capacity similar to his former connection.

The Sullivan Machinery Company has moved its Knoxville, Tenn., office, of which E. L. Thomas is manager, from 614 Market street to 623 Market street. Charles B. Officer, assistant to the president on engineering matters, has been promoted to chief engineer.

Herbert H. Moffitt, who has for some time represented the company as southeastern sales representative, with headquarters at the Woodward building, Washington, D. C., has been appointed vice-president in charge of sales for the southeastern district, with the same headquarters.

F. O. Salee, sales manager of the pump and tank division of the Wayne Tank & Pump Company at Fort Wayne, Ind., has been appointed sales manager of the Domestic Appliance Division, succeeding F. S. Fenton, Jr., resigned. Mr. Salee will be succeeded by A. D. Carriger.

A. E. Pratt has been placed in charge of the railway sales of Duco and other finishing materials of E. I. duPont de Nemours & Co., with headquarters at Parlin, N. J. Mr. Pratt was born at West Scarborough, Me., on December 11, 1887, and was educated at Mount Union College and Western Reserve University. After leaving college he spent two years in the maintenance of way department and signal construction on the western lines of the Erie. In October, 1909, he was appointed supervisor of signals of the Buffalo Creek at Buffalo, N. Y. In January, 1913, he returned to the Erie and he served as general signal foreman of construction while automatic signals were being installed on four divisions. In November, 1916, he was appointed signal supervisor of the Buffalo division of the Erie and in April, 1917, was transferred to the Kent division, with headquarters at Marion, Ohio. On March 1, 1918, he resigned to go as sales engineer in the railroad department of the National Carbon Company. Early in 1922 Mr. Pratt was promoted to assistant manager and in January, 1923, was ap-

A. E. Pratt

pointed manager of railway sales of the National Carbon Company, Inc., and the Prest-O-Lite Company, Inc., which position he held at the time of his recent appointment.

T. J. Powell, formerly district manager for the Galena Signal Oil Company, St. Louis, has been appointed vice-president in charge of sales for the Union Railway Equipment Company, in southwestern territory, with headquarters at room 2089 Railway Exchange building, St. Louis, Mo.

George W. Morrow, supervisor of track of the New York, New Haven & Hartford, on June 1 will leave that position to join the sales staff of the Ingersoll-Rand Company, reporting to the Chicago office. He supplants E. F. Kultchar, who was recently transferred to the locomotive department.

The Crankless Engine Company of America, 29 Broadway, New York, announces through Dr. E. H. Armstrong of New York that contracts have been signed with a syndicate to manufacture crankless Diesel engines for railway, marine and industrial uses in large quantities. Production will start within 30 days.

Burt Fleeger, treasurer, sales manager and a director of Sivyer Steel Casting Company, Milwaukee, Wis., has resigned to become vice-president of the Oklahoma Steel Castings Company, Tulsa, Okla. This company is preparing plans for an extensive addition and is purchasing more equipment to increase its capacity of electric steel castings.

Charles E. Koch, who has served for some time in the Reading Iron Company's mills at Reading, Pa., will, in future, call on pipe buyers in the Reading territory of the Reading Iron Company, confining his efforts to Eastern Pennsylvania in the interests of Reading pipe. His headquarters will be at the general office of the company, Reading.

Walter C. Doering, representative of the Bradford Corporation, with headquarters at St. Louis, Mo., has been elected vice-president, with headquarters at Chicago. William D. Otter has been appointed manager of the Western district, with headquarters at San Francisco, Cal., to succeed W. W. Rosser, who has resigned to enter business for himself. Mr. Doering was born on September 12, 1886, in Bellville, Ill., and entered business with the St. Louis Car Wheel Company on January 1, 1900. This company was absorbed by the Southern Wheel Company in 1912, and until 1920 he held various positions with this company including assistant to the vice-president, and assistant to the president. In 1920 he was elected a vice-president. On January 1, 1923, Mr. Doering resigned from the Southern Wheel Company to engage in the railway supply business in St. Louis on his own account, representing the Bradford Corporation, the American Brake Shoe & Foundry Company, and the Pittsburgh Steel Products Company, which position he has held until his recent election.

W. C. Doering

The Hall Laboratories, Inc., has been organized, with Ralph E. Hall, formerly physical chemist, U. S. Bureau of Mines, as director. The Laboratories will act as consultatnts on the application of recent discoveries to the elimination of scale and corrosion in steam plants. The headquarters of the Laboratories are at 304 Ross street, Pittsburgh, Pa.

The Ludlum Steel Company, Watervliet, N. Y., is building a continuous furnace of modern construction and design, and is also enlarging and entirely rebuilding one of the ingot heating furnaces for its 18-in. mill. The Ludlum heat and scale resisting material is being used in the recuperative equipment of the billet heating furnace, also Delhi Tough in tube form.

Leslie S. Hall, whose appointment as president and general manager of the new company, Hall-Will, Inc., at Erie, Pa., was announced in the May issue of the *Railway Mechanical Engineer*, started in the machine tool field in Canada twenty-four years ago, with his father, under the name of John H. Hall & Sons. He designed all of the standard and special machines manufactured by that company, and also designed and built special machines for the tube mills of Canada and the British Munitions board. In 1920, Mr. Hall, as president, sold the company of John Hall & Sons to the Williams Tool Corporation, and was elected vice-president of both the Canadian and American companies, also general manager of the Canadian plant. Three months later he went to Erie and assumed the general management of both the Erie and Canadian plants. While in charge of the Erie plant, he designed the "Willie Williams" and "Williams Rapiduction" machines. On March 31 of this year he resigned as vice-president and general manager of the plant at Erie. He is still president and general manager of the Williams Tool Corporation of Canada, which is separate from the company at Erie.

L. S. Hall

G. C. Hay, formerly sales manager of the Williams Tool Company and now sales manager of Hall-Will, Inc., has had a wide experience in the machine tool field.

G. C. Hay

J. W. McLeod, works manager of the new company, has had ten years' experience in every phase of the pipe machine industry. For the past four years he was associated with the Williams Tool Corporation and, previous to that time, was in the same line of manufacture with John H. Hall & Sons, Canada.

J. W. McLeod

Fred C. Rumball, branch manager of the Timken Roller Bearing Service & Sales Company, with headquarters at Kansas City, Mo., has been promoted to sales engineer, automotive division of the Timken Roller Bearing Company, with headquarters at Cleveland, Ohio, and will be succeeded by J. M. Carey, salesman. T. F. Rose, assistant branch manager of the Timken Roller Bearing Service & Sales Company, with headquarters at Chicago, has been promoted to branch manager with headquarters at Cincinnati, Ohio. H. C. Sauer, assistant branch manager, with headquarters

at Cleveland, has been promoted to branch manager, with headquarters at Detroit. The branch office at Baltimore, Md., has been closed and service will be supplied through the Richmond, Pittsburgh and Philadelphia branches.

James T. Waite, formerly New England sales engineer of the Whitman & Barnes Manufacturing Company, has been appointed general sales manager of the New Process Twist Drill Company, Taunton, Mass. George R. Hine, formerly general superintendent of the Whitman & Barnes Manufacturing Company, has been appointed works manager of the New Process Twist Drill Company, in control of the company's entire line of twist drills and other products.

Alexander S. Henry was, on May 14, elected president of the Railway Steel-Spring Company, Inc., which is now a subsidiary of the American Locomotive Company. Mr. Henry's early experience in the iron and steel business was obtained among the steel mills of the Cleveland district and vicinity, where he served in various capacities, principally in the open-hearth departments. He later entered the employ of one of the steel-tired wheel plants in Cleveland which subsequently became a part of the Steel-Tired Wheel Company, and during its existence he was in charge of the local management of a number of its plants. When the company was merged with the Railway Steel-Spring Company in 1902, he was called to New York and appointed assistant secretary, acting in a supervisory capacity in the selling and operating departments of the steel-tired wheel and the steel tire divisions of the Company. In 1910 he was elected a vice-president and assumed charge of the operations of the various plants of the company, including the tire-plants at Latrobe, Pa., and Chicago Heights, Ill. In 1920, he was elected a director of the company and a member of the executive committee.

A. S. Henry

On June 1st the draft gear activities of the Westinghouse Air Brake Company were assumed by the Westinghouse Friction Draft Gear Company, with sales headquarters at Room 913, Peoples Gas Building, Chicago. This change has been made to more effectively serve the demand for the type N draft gear. H. B. Gardner, formerly a representative of the Westinghouse Air Brake Company in the New York district, has been appointed general sales Manager of the Draft Gear Company, with headquarters at Chicago.

A. S. Osbourne, president of the Universal Packing Corporation, Pittsburgh, Pa., has resigned to go as mechanical officer with the Pittsburgh Terminal Coal Company. Alexander M. Donnan, secretary and treasurer, has resigned, and has been appointed on the legal staff of the Pennsylvania Railroad. J. J. McQuillen, vice-president of the Universal Packing Corporation, has been elected president; J. M. Bandish, southern district sales manager, has been elected vice-president, and Herbert Lewis has been appointed manager of railroad sales with headquarters at Pittsburgh, Pa.

J. Barraja-Frauenfelder & Co., New York, has been established, a consulting and advisory service on oil and Diesel engines, their application to the industries and the manufacturing or applying of this equipment. The organization is composed of J. Barraja-Frauenfelder, executive engineer; Heinrich Schneider, associate engineer; Edward C. Magdenburger, associate engineer, and others who have had many years of theoretical and practical experience in this and allied branches of engineering. Mr. Schneider is an authority on Diesel engine design, testing and manufacturing, especially as applied to railroad installation; also an authority on hydraulic transmission. The establishment of a testing laboratory fully equipped for material and other testing also is planned so that complete research work can be carried out by the staff of the organization.

Edwin S. Mills, general manager of sales of the Illinois Steel Company, Chicago, has been elected a vice-president. Besides being general manager of sales of the Illinois Steel Company, he is manager of sales of the Tennessee Coal, Iron & Railroad Company, and of the Carnegie Steel Company, all subsidiaries of the United States Steel Corporation. He was born at New Brighton, Pa., on June 5, 1870, and entered business as manager of sales of the Carnegie Steel Company, Cleveland, Ohio, in 1895. From 1910 to 1919 he was subsequently general manager of the Pittsburgh Steamship Company, agent of the Oliver Iron Mining Company, assistant to the vice-president of the United States Steel Corporation at New York, and special sales agent of the Carnegie Steel Company. In 1919 he was promoted to general manager of sales of the Illinois Steel Company, which position he has held until his recent election.

Victor Angerer, well known in both the street and steam railroad field died of pneumonia at his home in Ridley Park, Pa., on May 5, at the age of 64. He was a native of Austria, and graduated at the age of 17 from the Technical College in Vienna. Shortly afterwards he came to the United States, and for about four years he was with William Sellers & Co., Philadelphia, in the capacity of draftsman. In 1884, he associated himself with William Wharton, Jr., & Co., Ltd., as a mechanical engineer. After serving in various engineering and supervisory capacities he became vice-president and general manager in 1902. For some years he taught in the Franklin Institute, Philadelphia. Upon the consolidation of William Wharton, Jr., & Co., and the Taylor Iron & Steel Company, in 1912, when the Taylor-Wharton Iron & Steel Company was formed, he was made vice-president of the latter company and of its subsidiaries, William Wharton, Jr., & Co., Inc., Easton, Pa., the Philadelphia Roll & Machine Company and the Tioga Steel & Iron Company, Philadelphia. In 1922, he was made a director, holding this position until his death. He introduced the use of manganese steel in electric railway track work in 1894 and in steam railroad track work in 1899. He was also author of various general designs of manganese steel track structures now in general use.

Frederick F. Fitzpatrick, president of the Railway Steel-Spring Company, was on May 14 elected president of the American Locomotive Company. This election was in accordance with the plans of the amalgamation of the Spring Company and the American Locomotive Company originally announced last March. W. H. Woodin, hitherto president of the American Locomotive Company, has been elected chairman of the board of that company. Mr. Woodin is also president of the American Car and Foundry Company. Alexander S. Henry, formerly vice-president of the Railway Steel-Spring Company, was elected president and Mr. Fitzpatrick chairman of the board of the Spring Company. Mr. Fitzpatrick, has been president of the Railway Steel-Spring Company since 1910. In 1898 he was appointed St. Louis representative of the Charles Scott Spring Company which was merged with the Railway Steel-Spring Company upon its organization in 1902. In 1905, three years after the formation of the Railway Steel-Spring Company, he was made general sales agent, with headquarters in New York. He was elected a vice-president, in charge of sales in 1907, and president of the company in 1910.

F. F. Fitzpatrick

The Railway Steel-Spring Company will continue to operate as it has always done; no changes whatever are contemplated in the management or personnel.

Trade Publications

RIVETING HAMMERS.—An eight-page, illustrated folder descriptive of the new Thor riveter construction has been issued by the Independent Pneumatic Tool Company 600 W. Jackson boulevard, Chicago.

CRANES.—Electric and hand-power traveling cranes, cranes for freight handling, and the Whiting portable car hoist are illustrated in three, four-page folders which have been issued by the Whiting Corporation, Harvey, Ill.

POWER PLANT EQUIPMENT.—Ernest E. Lee Company, 115 S. Dearborn street, Chicago, is issuing Catalogue No. 26 descriptive of power plant equipment manufactured by the various concerns it represents in Illinois, Wisconsin, Indiana and Iowa.

MEEHANITE METAL.—A four-page, illustrated folder descriptive of Meehanite metal has been issued by the Whiting Corporation, Harvey, Ill. This metal is a pearlite iron having unusual physical properties, with a tensile strength varying from 45,000 to 70,000 lb. per sq. in., as against 20,000 to 30,000 lb. for ordinary grey iron.

VENTILATOR WINDOWS.—The Bogert & Carlough Company, Straight street, Paterson, N. J., has just published a 16-page catalogue, No. G-26, entitled "Boca Top and Bottom Sliding Ventilator Windows with Bronze Guides." It describes in detail the architectural and industrial types of projected windows and illustrates in color the Boca bronze guide feature.

STEAM TURBINE INSTRUMENT.—The Uehling Instrument Company, 473 Getty avenue, Paterson, N. J., is distributing catalogue No. 150, descriptive of its combined barometer and vacuum recorder for use with steam turbines. Valuable turbine performance data, typical charts, sectional views and dimension diagrams, including reference to a new model instrument for flush mounting on panel boards, also are included in the catalogue.

STEAM ECONOMY.—Catalogue S-22, descriptive of Republic installations in many industries and the theory and construction of steam flow meters, has been issued by the Republic Flow Meters Company, 2240 Diversey Parkway, Chicago. The information contained in the catalogue is a compilation of the experience of the company's engineering force, covering a period of five or ten years on the subject of methods for reducing steam costs.

WROUGHT PIPE.—A new educational motion picture film, entitled "The Arteries of Industry," is described in a 16-page folder which has been issued by the National Tube Company, Frick building, Pittsburgh, Pa. This film illustrates the process of manufacture of National pipe, step by step, from the mining of the ore to the final tests and inspections. Many of the more important steps also are illustrated graphically by animated diagrams.

FORGED TOOLS.—Amplified wrench index tables, giving dimensions of wrench openings to fit standard nut and bolt sizes, and a number of new tools appear in the 120-page catalogue of mechanics' tools being issued by the Billings & Spencer Company, 721 Main street, Hartford, Conn. Open end machine wrenches; spanner wrenches; machine and socket wrench sets; wrench boards; socket and adjustable wrenches; pliers; screwdrivers; chisels; hammers; chain pipe wrenches, both single and double jaw; dogs, C-clamps; ratchet drills, and miscellaneous standard forgings are listed in this catalogue.

CHUCK WORK.—This is the second section of the publications on chuck work and the third and final one of a series of booklets issued by the Warner & Swasey Company, Cleveland, Ohio, dealing with modern methods of tooling turret lathes. Three chapters of this booklet are of particular interest—the discussion of piloting, the treatment of permanent set-up and a chapter devoted to a consideration of the economic advantages of specially designed tooling equipment for turret lathe work. In this, together with the two foregoing books, the shop man will find the answers to many questions concerning equipment and methods which will be of valuable assistance in planning both small lot and quantity production jobs on turret lathes.

Personal Mention

General

FRANK S. ROBBINS, formerly Philadelphia representative of the Pittsburgh Testing Laboratories, has been appointed superintendent of motive power and machinery of the Florida East Coast, with headquarters at St. Augustine, Fla.

Master Mechanics and Road Foremen

F. W. FOLTZ has been appointed road foreman of engines of the Eastern division of the Missouri Pacific succeeding F. W. Gratiot.

ALBERT C. DUNN has been appointed road foreman of engines of the Delaware division of the Pennsylvania, succeeding S. V. Sproul, deceased.

H. C. GUGLER, master mechanic of the Chicago, Burlington & Quincy, at Wymore, Neb., has been transferred to Sheridan, Wyo., succeeding Mr. Johnson.

G. E. JOHNSON, master mechanic of the Chicago, Burlington & Quincy, at Sheridan, Wyo., has been transferred to Wymore, Neb., succeeding H. C. Gugler.

EDWARD F. SMITH has been appointed road foreman of engines of the Yellowstone division of the Northern Pacific, with headquarters at Forsyth, Mont.

JAMES A. REDDEN, engineman on the Delaware division of the Pennsylvania, has been promoted to assistant road foreman of engines of the Baltimore division.

Shop and Enginehouse

J. R. VOGELSINGER, boiler foreman of the Erie at Dunmore, Pa., has been transferred to Hornell, N. Y., as general boiler foreman.

Car Department

W. H. FOWLER has been appointed general car foreman of the Southern Pacific, lines in Texas and Louisiana, with headquarters at Houston, Tex., succeeding J. D. Freeman, who has retired.

GEORGE SEELEY, assistant chief draftsman at the Keyser Valley shops of the D. L. & W., at Scranton, Pa., has been appointed assistant master car builder, with headquarters at Hoboken, N. J., succeeding J. P. Brogan, deceased.

Obituary

HARLEY E. DUTTON, purchasing agent of the Green Bay & Western, died recently, after many months' illness.

EDWARD POSSON, who was retired as engineer of car construction of the Atchison, Topeka & Santa Fe on July 1, 1924, died on March 7.

W. F. RENSHAW, formerly general superintendent of motive power of the Illinois Central, who retired in 1908, died at Chicago on May 8 at the age of 75 years.

J. P. BROGAN, assistant master car builder of the Delaware, Lackawanna & Western, with headquarters at Hoboken, N. J., died suddenly in Florida on May 3. Mr. Brogan was born in Scranton, Pa., on February 10, 1877. He secured his early education in that city, and in 1906 entered the car shop of the D., L. & W. at Scranton, under Mr. McKenna, who was then master car builder. He subsequently worked in the mill, light repair, heavy repair, erecting, machine and pipe shops, and assisted in putting the first air brakes on D., L. & W. cars. During this time Mr. Brogan had been attending the Scranton Business College at night. He graduated as a bookkeeper and stenographer, and in 1898 was appointed to the position of stenographer at the Dover, N. J., cars shops, and in 1899 became chief clerk in the car department at the Hoboken terminal. In 1908 he was appointed general foreman of the car department at Hoboken, and in 1918 became assistant master car builder of the entire system.

Railway Mechanical Engineer

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Influence of the motor bus

From the standpoint of one accustomed to the riding characteristics of modern passenger cars, the motor bus appears to possess a severe handicap, partly because of the uncertain conditions of the line and surface of the roadways on which it must operate and partly because of the characteristics of a vehicle which must be made to operate successfully on such rough roadways. It is, perhaps, owing to these very handicaps that so much attention has been given by the designers of automobile and motor bus bodies to the development of seats which, both in the comfort—even luxury—of their form and upholstery tend in a measure to relieve the road shocks which cannot be kept out of the body of the vehicle and which in some cases may be intended to distract the attention of the patron from the inherent disadvantages of the road vehicle. Whatever may be the reason it is evident that in the motor bus considerably more has been done in recent years in the development of seat comfort than has been evident in the case of railroad passenger coaches. The influence of this new development, however, partly because of its growing competition and co-ordination with railroad service, is beginning to be felt by the designers of passenger coaches and coach equipment. It is well worth the study of railroad officers interested in the equipment of passenger coaches because, while what has been done with the road vehicles, is not directly applicable to the passenger car, it is suggestive of what can be done, in modified form, in the passenger car. The argument that present equipment is sufficiently luxurious and ought to satisfy the traveler is not sufficient to justify inattention to this new development.

A future benefit of standard cars

One of the marked trends of the times in the field of car repairs is the application of the principles of repetitive operations and the specialization which characterizes so many American producing industries. On another page in this issue will be found an interesting account of the application of these principles in the Little Rock car shops of the Missouri Pacific where the operations have been organized on the station to station basis. The operations described in this article pertain to the rebuilding of a series of flat cars, and it is significant that the specialization of operations by stations, with the concentration of the deliveries of each class of material at individual stations, is reported to have effected a reduction of 38 per cent in the rebuilding cost. Probably one of the greatest difficulties in the way of securing to the full the advantages of this type of specialization in car repairs is to take out of service cars of a single series in sufficient number to maintain the continuous program of rebuilding required to permit a highly specialized organization of facilities especially adapted to the one series of cars. In the article already referred to, it is probable that less difficulty in this respect was encountered than would be the case were a series of box cars under consideration, because of the generally greater extent to which the latter are scattered in interchange. In this connection, it is worth while calling attention to the fact that with the adoption of standard box car designs, if these designs are generally utilized by the railroads, the differences in cars of various series on any individual road will gradually become of such minor character that they need not interfere with a highly specialized shop program involving cars of two or perhaps more series. It seems probable, then, that the program of standardization now being advanced with such satisfactory progress by the American Railway Association will greatly simplify the future application of specialization in freight car rebuilding by the railroad, and that it will probably greatly increase the extent to which specialization may be made to reduce rebuilding costs.

Purchasing locomotives for economy

Quite often the mechanical department officers of a railroad as well as the locomotive builders have been placed in an awkward position by the insistence of the executive on having new locomotives about to be purchased equipped with 100 per cent boilers. It is a common saying that a locomotive is as good as its boiler, but up to the present time no one has been able to define a 100 per cent boiler. Of course, the efficiency of a boiler can be calculated, and is calculated when designing new power. However, boiler efficiency is effected not only by the design of the boiler but by the grade of coal used and by the rate of operation as well. A maximum combined efficiency for a locomotive boiler has never reached 100 per cent although the application of superheaters and feedwater heaters have increased the efficiency to a figure closely approaching 90 per cent. What is really desired by the railroad is a locomotive that can furnish maximum sustained horsepower or tractive force at speeds and such performance can only be obtained by providing a boiler of adequate steaming capacity.

Evidence that this important factor in locomotive design is receiving due consideration from both the mechanical department of the purchasing railroad and also the builders, is shown in some of the new motive power that has been purchased during the past few years. The feature in many locomotives of recent design has been the procurement of the required maximum sustained horsepower by the use of a boiler having ample

proportions, a firebox having ample grate area, heating surface and volume, and the application of the latest design in feedwater heaters, superheaters and stokers. In the final analysis it is the performance and economy of operation with which the executive is most concerned, and these are facts which can only be determined by trial in actual operation. The policy of determining these facts in advance has recently been followed by two railroads, one in the east and the other in the west, both of which purchased one locomotive for test before ordering more of the same design.

Diesel locomotive development

Elsewhere in this issue will be found a description of the second Diesel locomotive built by the Hohenzollern Locomotive Works at Dusseldorf, Germany, for the Russian State Railways. This locomotive is essentially a combination of a marine type Diesel engine, not primarily designed for locomotive use, with a quite conventional type of steam locomotive running gear. This locomotive is like its predecessor in respect to the power plant, but where the first locomotive utilized electric transmission, the present locomotive utilizes a mechanical transmission with magnetically operated clutches. Not many years ago in the early discussions of the possibility of using the Diesel engine as a locomotive prime mover the development of a satisfactory transmission was considered to be one of the most important, if not the most difficult, problems to be solved in connection with this development. The electric transmission, already well developed in its essential features, has now proved its entire practicability as an operating medium. In connection with the comparatively slow speeds of the best developed Diesel engines of the present time, however, it is open to the objection of its rather high weight which, in considering locomotives of sufficient size to meet general road service requirements in America, is a matter for serious concern.

With the mechanical transmission installed in the new Russian locomotive, combined with a type of Diesel engine not ideally adapted to locomotive service, it has been possible to develop a 1,200-hp. locomotive with a total weight of about 230 lb. per hp. of the prime mover, with an overall thermal efficiency on test of about 30 per cent. The new form of transmission, if a sufficient period of service demonstrates its practicability from an operating and maintenance standpoint, has the advantage of high efficiency, light weight and probably lower first cost, but it obviously does not possess the same degree of flexibility in the application and utilization of the power of the rail as does the electric transmission. This would suggest the possibility that with the comparatively low speed Diesel engines at present available, the mechanical transmission will be best adapted to road service where speed variations of the locomotive are largely confined within the range of the practicable speed variations of the Diesel engine, while the electric transmission will be far better adapted to services requiring frequent stops and starts and wide speed variations beyond the practicable range of engine speed variations, such, for instance, as switching service.

But there is the future possibility of the development of a Diesel engine operating at a crank shaft speed more nearly approaching that of the automobile engine than is customary at the present time. This will materially reduce the disadvantages of weight and first cost of the electric type of transmission, although a practicable mechanical type of transmission will still probably retain the advantage of higher efficiency.

That it has been possible to build a 1,200-hp. locomotive using an engine designed for an entirely different purpose and still keep within a weight of 230 lb. per horsepower is a very encouraging indication that neither present limitations of power capacity nor unit weight need be considered as anything but temporary. The submarine Diesel is a highly effective and reliable machine in its field. In Germany, particularly, its development, due to necessity, was rapid during the war. It would be extremely hazardous to attempt to prophesy the advances which a like amount of effort in the adaptation of this highly efficient form of prime mover to the specialized requirements of rail limitations may bring forth in the next few years.

Give the shop efficient material handling equipment

Prompt, accurate and economical delivery of material is one of the principal factors in car and locomotive shop production. That the importance of this factor is well understood and appreciated by the majority of mechanical and stores department officers is shown by the large number of shops in which well organized delivery systems have been installed. Still the best planned and most efficient system of delivery will not function 100 per cent unless the right kind of equipment is provided. As an example of the amount of material that is handled in many railroad shops, the case of a central car and locomotive repair point, located in the middle-west, can be cited at which over 9,500 carloads of company material is received in a year, approximately 30 per cent of which is used in the car and locomotive shops at that point. This means that a little over nine carloads of material is delivered to these two shops, each working day of the year. Because of the fact that a car and locomotive shop must, owing to the character of the work performed, spread over considerable territory, much time can be lost in handling this material over comparatively long distances unless the right kind of equipment and road facilities are provided.

Delivering material from the stores department to the car or locomotive shop is, however, only a part of the material handling problem. Appearing elsewhere in this issue is an article on handling material in railroad shops in which are given a number of illustrations showing applications of material handling equipment to various jobs occurring in shop operation. They are many jobs, such as moving heavy castings from one machine to another, or from the erecting shop to the machine shop and vice versa, for which special trucks or cranes can be used to advantage. For such work, many manufacturers are able to provide special equipment which is designed with the principal object of obtaining speed and reducing labor costs.

The work performed in the average railroad car or locomotive shop usually covers a considerable area and is done most efficiently on the same level. It is not generally practicable to centralize the work in a building of two or more stories where the material can be handled by conveyor or elevator. Furthermore, production is governed by the classes of cars and locomotives going through the shop, which is in turn governed by the railroad's traffic requirements. This makes the problems of production and handling material unlike those to be solved in the average manufacturing plant, and the highly specialized equipment found to render good service in manufacturing work will not always prove suitable in car or locomotive repair work. Material handling equipment, to be best adapted to railroad requirements, must

be able to make long hauls with heavy loads, out of doors under adverse weather conditions. Furthermore, no matter how well a car repair yard may be provided with hard-surface driveways, there will be times when a truck may have to work on the natural soil or in the mud.

The types of motorized equipment which are becoming available in constantly increasing variety are offering many opportunities for overcoming handicaps set up by the inflexibility of existing plant layouts or the lack of specialized facilities built into the plants themselves.

To err is human

The mechanical department officer is constantly confronted with the problem of maintaining accuracy in the work of his department. His work involving many or all of the various elements of mechanical engineering requires close attention to details as well as the bigger problems of organization and management. Engineering is an exact science and even though speed in production must be attained, that primary factor of accuracy must also be maintained. This point was discussed at considerable length in an address made by C. E. Johnson, vice-president and general manager, Kansas City Southern, before the Maintenance of Way Club, Chicago, on May 19. Mr. Johnson in dwelling on the shortcomings of human nature stated: "The man who says he never makes a mistake is either a liar or a loafer. Human nature is fundamentally imperfect and because of this fact, mistakes are made wherever human nature is employed. In every business, be it that of manufacturing calico dresses, selling ice cream cones, running a peanut stand or keeping books, errors of various kinds are constantly being made. Nor does recognition of the fact that 'to err is human,' obviate the necessity for enduring the commitments of error.

"Mistakes are expensive. They waste time, not only that involved in their perpetration, but also that necessary for their correction, both of which expenditures would be saved if the mistakes had not been made. Errors cost customers, money, time, goods, material, men or jobs, depending on the nature of the business and the tolerance of the one on whom the brunt of the error falls. In any event the sequence of errors is inescapable. Almost no price is too high to pay for increased accuracy."

The tendency in modern locomotive and car shop production is for accelerated speed. Speed is profitable if coupled with accuracy, but it is a nihilist if married to inaccuracy. This fact should mean much to mechanical department officers, since it should cause them to consider the elimination of errors before endeavoring to speed up production. Too often production takes precedence over efficiency and safety, both of which are products of accuracy.

Terminal practices and repair costs

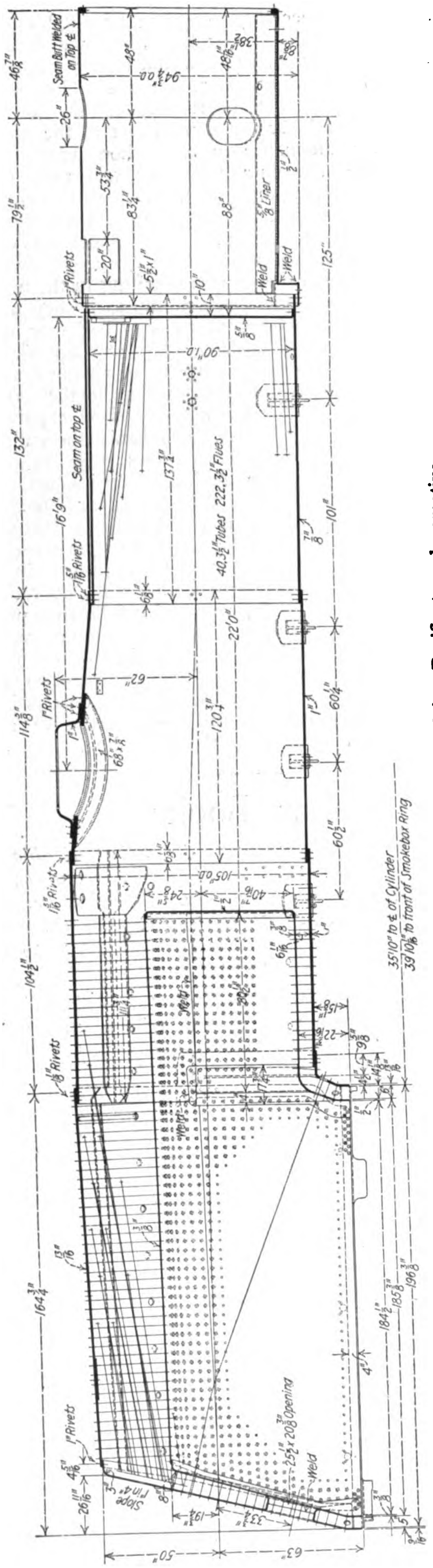
There can be no question that even with locomotives of the same class and service making the same mileage between general repairs, the cost of these repairs will vary, depending upon the kind of conditioning work performed at engine terminals. Among the things which can be done in enginehouses to reduce the cost of classified repairs may be mentioned the following: (1) Keep the pound out of driving boxes and rods; these are responsible for much expense in the back shop due to fractures in frames, axles, crank pins and driving and piston rods. Many side rods crack through the knuckle pin oil hole, making it necessary to apply a new rod, costing perhaps $50, when the application of a new knuckle pin bushing at a cost of $1.45 would have prevented a fracture. (2) Keep the binders tight. The proper attention to assure tight binders will also do much to prevent cracked and broken frames, one of the expensive items of maintenance in back shop work. (3) Wash the boilers as often as necessary, with great care. The degree of thoroughness with which this operation is performed has a vital influence on the formation of scale, necessitating firebox and boiler sheet renewals. (4) Avoid repeated hammering of leaky staybolts which starts fractures in the sheets, also resulting in the necessity of applying new side sheets at the back shop when this work would have been unnecessary had new staybolts been applied when needed. (5) Don't work the flues too much. If expanders are used, any expansion of the flues beyond that necessary to make them tight in the flue sheets, results in excessive sheet expansion and the development of cracks. (6) Resist the temptation to rob material from locomotives prior to their being sent to the back shop for heavy repairs, with the idea of getting new parts in place of old or otherwise undesirable parts and charging the expense to the back shop. The back shop should assist the enginehouse by turning out locomotives after general repairs in as nearly as possible 100 per cent condition for operation. The enginehouse should reciprocate by following practices in locomotive conditioning and running repair work which will keep the locomotives in the best condition for efficient operation on the road and at the same time prevent the development of slight defects into serious ones, necessitating subsequent extensive and expensive repair operations in the back shop.

New Books

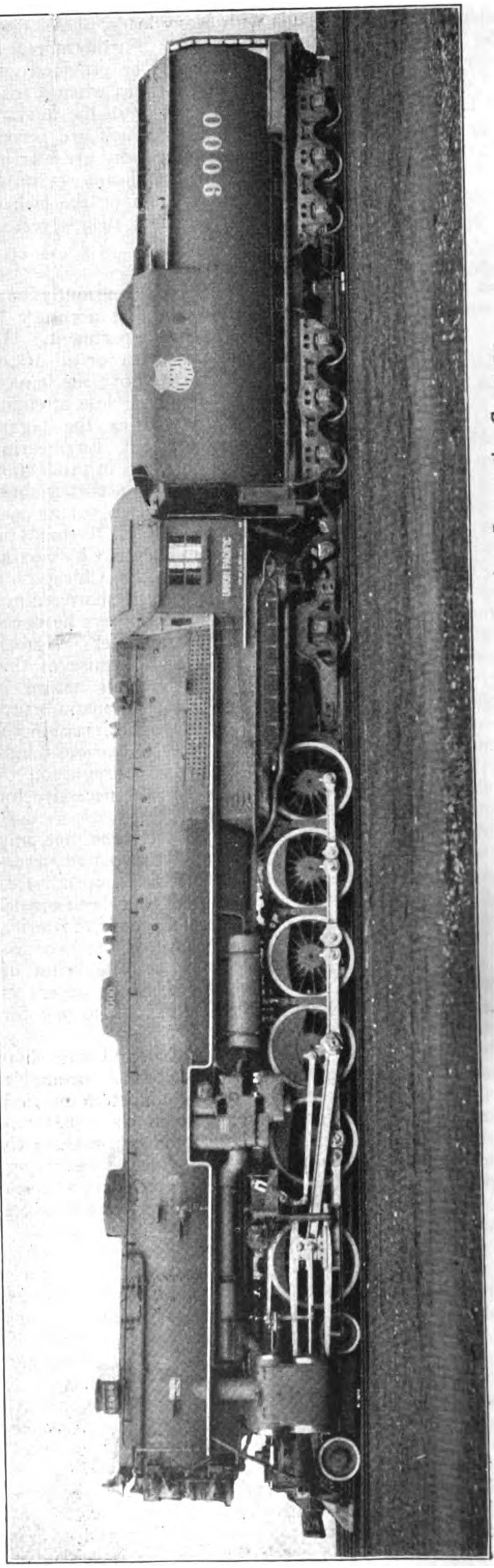
Up-to-date air brake catechism. *By Robert H. Blackall. Revised and rearranged by F. H. Parke, general engineer, Westinghouse Air Brake Company, Wilmerding, Pa. Published by The Norman W. Henley Publishing Company, 2 West 45th St., New York. Bound in cloth, 7½ in. by 5 in., 710 pages, illustrated. Price $4.00.*

The Air Brake Catechism by Robert H. Blackall, has for many years been popular with railroad men whose work require a knowledge of the construction, operation or maintenance of air brakes. This, the thirtieth edition, has been revised by F. H. Parke of the Westinghouse Air Brake Company, who is a well-known authority on air brakes. Mr. Parke, following the method of question and answer used by Mr. Blackall in his earlier editions, has thoroughly covered the detailed construction and operation of the various types of Westinghouse air brakes used not only on railroad cars and locomotives, but on self-propelled rail cars and automotive equipment as well.

The book contains 250 questions and answers which cover in detail the ET locomotive brake, the K type quick service freight triple valve, the empty and load freight brake, the old PM high-speed brake, the LN passenger equipment, the present day PC and UC passenger brake equipments and the various steam and motor-driven air compressors. The book also covers the Westinghouse equipment for electric locomotives, high-speed electric passenger trains, motor trucks, buses and automobiles and gasoline motor-rail cars. There are also chapters on the standard terminal and compressor tests, hose specifications, train handling and inspection, foundation brake gear diagrams, tables, formulas and other useful information.



Sectional elevation of the boiler of the Union Pacific type locomotive



Three-cylinder Union Pacific type locomotive No. 9000, built by the American Locomotive Company

4-12-2 locomotive for Union Pacific

Built for fast freight service in mountain districts— Has 67-in. drivers and develops a rated tractive force of 96,650 lb.

ON April 9, 1926, the American Locomotive Company delivered a 4-12-2 type locomotive to the Union Pacific to be used in fast freight service in the mountain districts of that road. This locomotive, known as the Union Pacific type, is the largest non-articulated steam motive power unit ever constructed. The driving wheels are 67 in. in diameter which is somewhat larger than the usual diameter of drivers on locomotives designed for fast freight service, a 63-in. driver being generally accepted as about the proper diameter for such service. It was found, however, that a good crank axle design required a 67-in. driver which tended to improve the whole design of the locomotive for the work for which it was intended.

The design of the locomotive as a whole embodies straight engineering throughout, combining a number of accepted features in a manner that has not been used before in order to obtain the characteristics desired within the specified weights and clearance limitations. The locomotive develops a rated tractive force of 96,650 lb. The boiler steam pressure is 220 lb. per sq. in. The diameter and stroke of the outside cylinders is 27 in. by 32 in. and the inside, 27 in. by 31 in., the main rods for the two outside cylinders being connected to the No. 3 drivers and the main rod from the inside cylinder to the No. 2 drivers.

The total weight of the locomotive is 495,000 lb., of which 355,000 lb. is carried on the drivers, 80,000 lb. on the engine truck and 60,000 lb. on the trailing truck. The total length of the driving wheel base is 30 ft. 8 in., but by installing lateral motion devices on the No. 1 and No. 6 drivers, the designers were able to reduce the total rigid wheel base to 17 ft. 6 in.

Design is result of extensive tests of other types

The selection of the 4-12-2 design was the result of a series of extensive studies and tests made by the railroad management extending over a period of several years. These tests included an investigation of the operating costs of the 2-8-8-0 Mallet type, two-cylinder 2-10-2 type, and three-cylinder 4-10-2 type locomotives, a comparison of the principal dimensions, weights and proportions of which is given in one of the tables.

The 2-8-8-0 type locomotives were designed for service on the principal mountain grades of the Union Pacific, but during certain seasons, they were placed in road service between Green River, Wyo., and Laramie, where the maximum grade is .82 per cent. Considerable reductions were obtained in operating costs through the use of the Mallet locomotives but owing to the fact that locomotives of this type are inherently a low speed machine, they could not be used in this district during the busiest season.

Since 1917 the standard locomotive for fast freight service in the mountain districts has been the two-cylinder 2-10-2 type which has a rated tractive force of 70,450 lb. About one year ago the Union Pacific purchased a three-cylinder 4-10-2 type locomotive (a description of which was published in the September, 1925, issue of the *Railway Mechanical Engineer*, page 557), for demonstration and comparison with 2-10-2 type.* This locomotive was built as nearly identical to the 2-10-2 type as the three-cylinder design would permit, having nearly the same weight on the drivers, the same grate area and practically the same design of boiler, and 63-in. drivers.

The comparative tests conducted with the three-cylinder 4-10-2 and the two-cylinder 2-10-2, developed that the three-cylinder locomotive could regularly handle 20 per cent more tons in regular service with an expenditure of 16 per cent less fuel per 1,000 gross ton-miles. As a result, the Union Pacific conceived the idea and co-operated with the builders to design a locomotive for fast

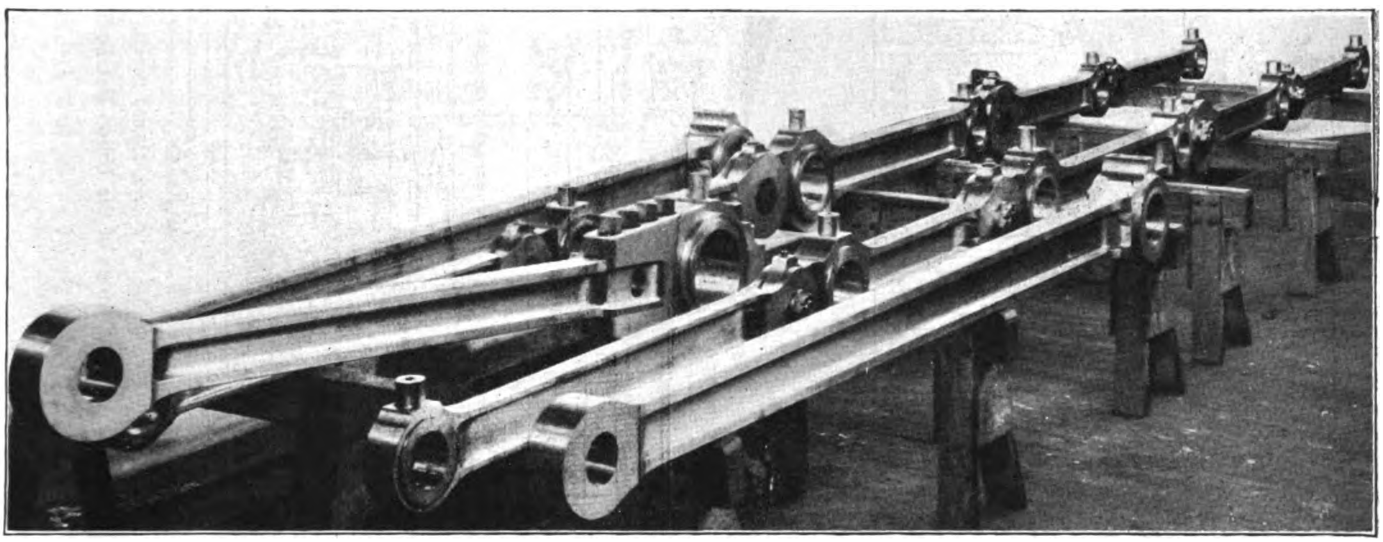
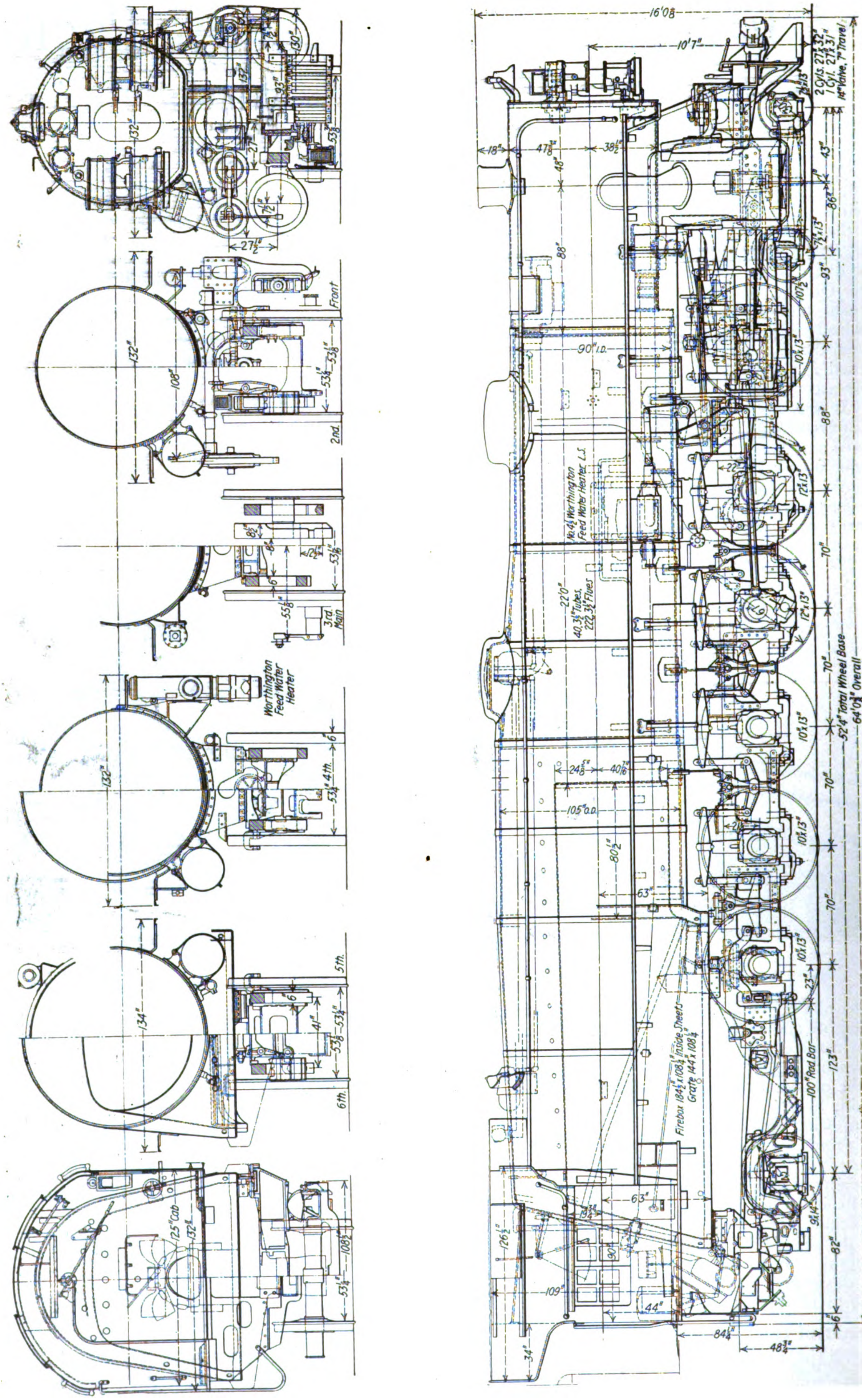


Illustration showing the arrangement of the side and main rods

* See the June, 1918, *Railway Mechanical Engineer*, page 321, for the results of the tests of the 2-10-2 locomotive on the Union Pacific.



Weight on engine truck, 80,000 lb.

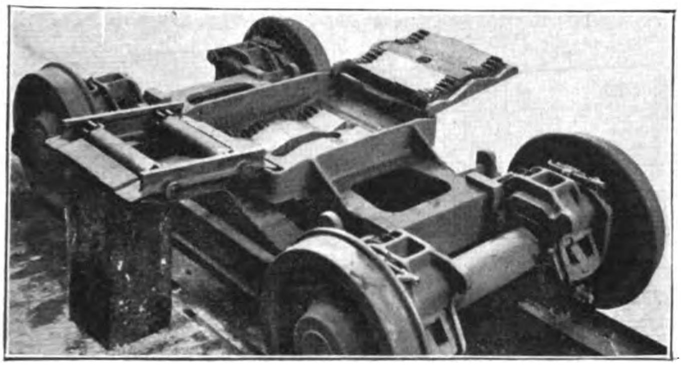
Weight on drivers, 355,000 lb.

Weight on trailer, 60,000 lb.

Elevation and cross section drawings of the Union Pacific Type Locomotive No. 9000

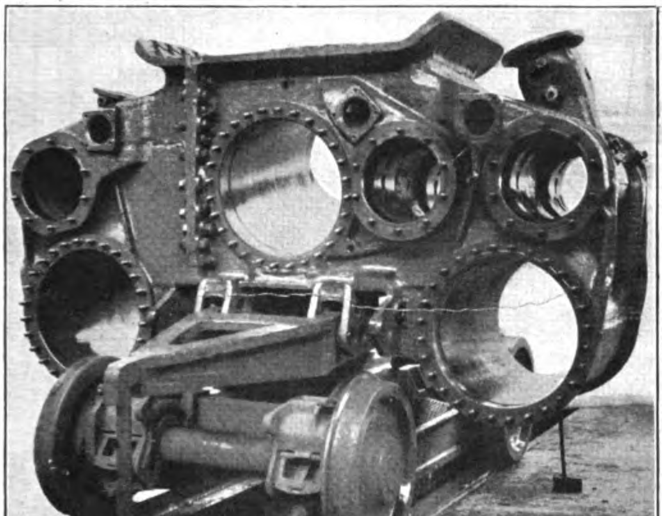
freight service capable of hauling the 2-8-8-0 tonnage and also of making the same speeds as made by the 2-10-2 and 4-10-2 type locomotives. In other words, it was desired to have an increase in permissible speed of from 20 m.p.h. to 40 m.p.h. and an increase in the average speed over the district of from 12 m.p.h. to better than 20 m.p.h.

The amount of power required together with a weight limit of 59,000 lb., per pair of drivers, determined the



Top view of the engine showing the construction of the centering device.

need for having six-coupled axles. Such a design was impossible on a two-cylinder locomotive having the main rods connected to a single driving axle. The three-cylinder locomotive, transmitting its power through two main driving axles, effects a better distribution of stresses over the whole frame structure. This factor, combined with the lower dynamic effects, made possible the use of six-coupled axles together with comparatively high speed



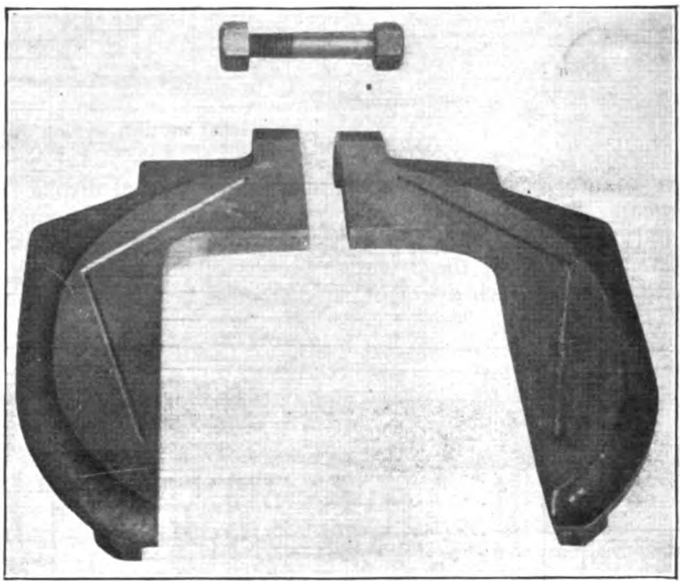
Rear view of the cast steel cylinders as assembled on the engine truck

and greater power. The final frame stresses are, therefore, somewhat less in the 4-12-2 type than they are on a 2-10-2 type having outside cylinders of larger dimensions.

The problem of arranging such a long wheel base as the 4-12-2 type to negotiate a 16 degree curve was solved by installing a lateral motion device at the rear as well as at the front drivers and applying a four-wheel engine truck and two-wheel trailer, the design of which allows a considerable amount of flexibility in curving. All the wheels are flanged with the exception of the No. 4 drivers which have blind tires. This arrangement permits the locomotive to traverse 16-deg. curves successfully at normal speeds. It has, however, been decided to have all the drivers flanged on future locomotives of this type.

Equipped with cast steel cylinders

One of the illustrations shows an assembly of the engine truck, front equalizer and cylinders. The cylinders are of cast steel, this being the first application of cylinders constructed of this material to a three-cylinder locomotive. The outside cylinders are placed horizontally in the usual manner while the center cylinder is built sloping at an angle of 9½ deg. to the horizontal. The steam pipe inlet, shown on the right hand side, supplies steam to both the right and center cylinders. It is designed to deflect any water which might be present in the incoming steam away from the center cylinder and into the right hand cylinder, from which the water can be more



Type of hub liners used on the engine truck boxes

easily drained. The cylinder casting is in two sections and is joined at the left of the center cylinder, as shown in the illustration. The exhaust passages from all three cylinders are cored to unite at the top of the casting in the usual manner. Gun iron bushings and rings are used in the cylinders and on the pistons and distributing valves.

The valves are of the piston type, size 14 in., and have a maximum travel of seven inches. A single ported valve is used having eight rings, which is the Union Pacific standard, instead of the usual four rings. The valves are operated by a Walschaert gear with the Gresley transverse lever arrangement for three-cylinder locomotives. This valve gear design illustrates the first use of an integral steel casting combining both link supports with a frame crosstie.

The steam pipe is enclosed in a Flextite casing which is a patented arrangement whereby the casing is welded to the outside of the smokebox and around the steam pipes. There is said to be a net saving in weight of approximately 80 lb. per locomtive and castings are eliminated, with attendant machine work and chipping. Properly welded, the casing will remain airtight indefinitely.

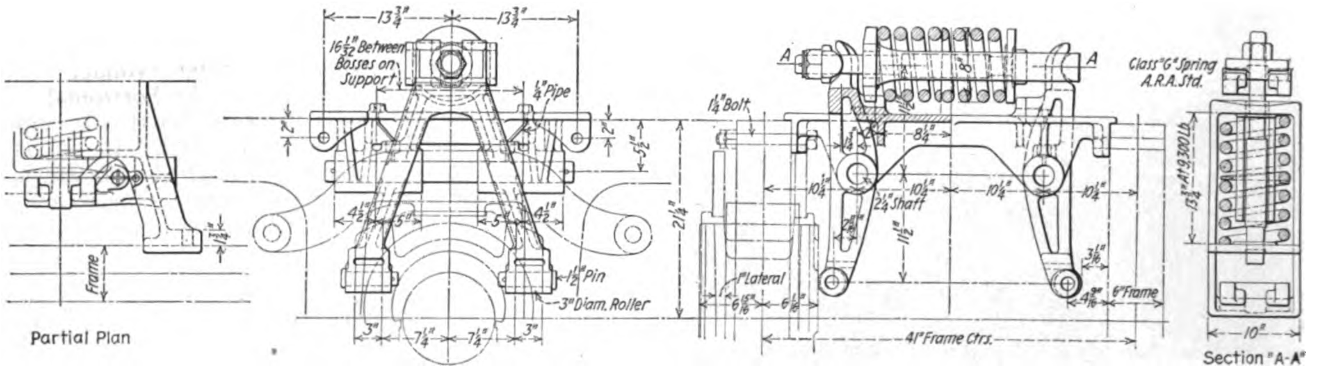
Design of running gear includes unique features

The design of the running gear involved a number of new problems owing to the fact that the locomotive would be required to traverse 16 deg. curves on six pairs of

driving wheels. This required an unusual amount of flexibility in the long driving wheel base but, as stated in a preceding paragraph, the designers were able to obtain a rigid wheel base of 17 ft. 6 in. by the use of lateral motion driving boxes applied to the front and rear axles.

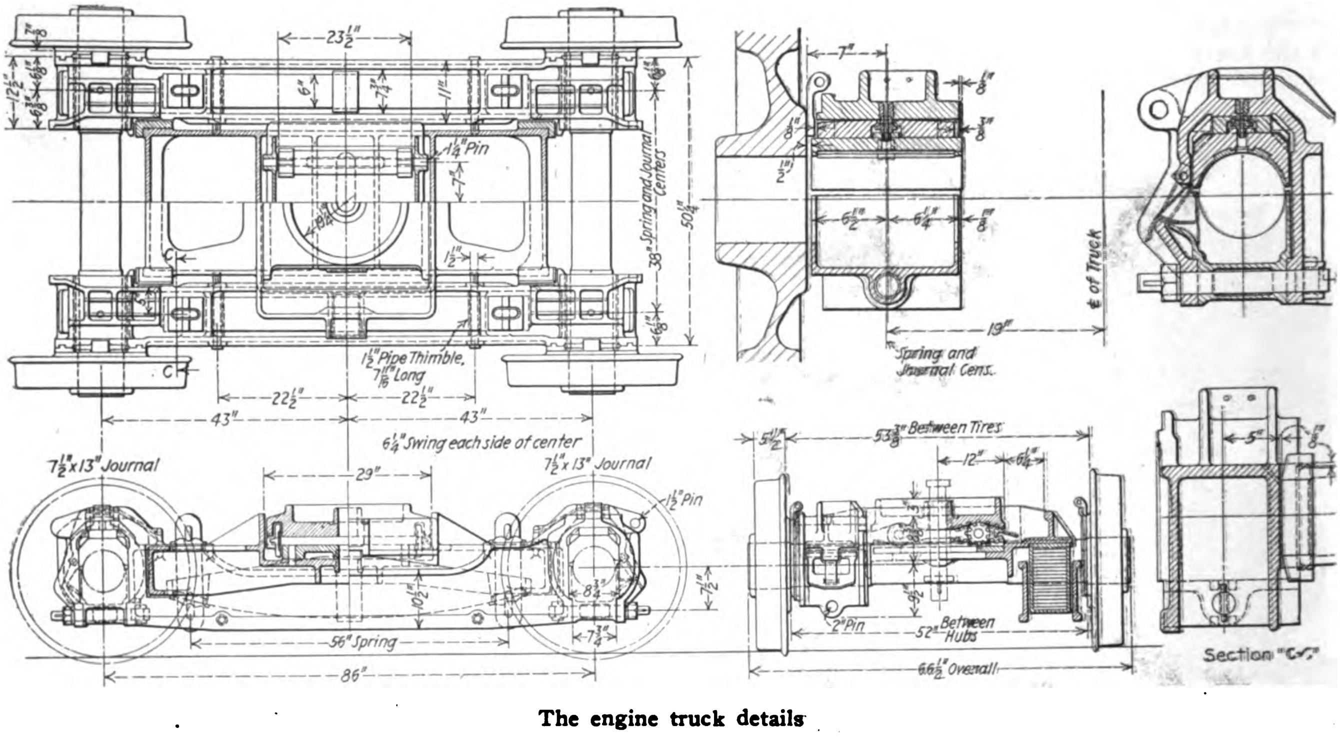
The lateral motion device shown in one of the drawings is adjustable to suit speed or curvature requirements, the resistance increasing with the amount of lateral displacement. It imposes no excess load on the driving springs and uses a Class G A. R. A. standard car spring to resist lateral motion of the drivers. Referring to the drawing, the rollers, which are 3 in. in diameter, bear against the inner surface of the driving box. Any lateral motion of the drivers is transmitted through the lever of the lateral motion device direct to the resisting spring. When the box is in a normal position in the frame, the rollers are clear of the inner surface which facilitates the work of replacement.

Shown in one of the drawings is the type of driving box applied to the main and crank axles. It is equipped with supplemental bearings below the center line of the axle for the purpose of reducing side wear on the journals. The grease lubricant used in the driving boxes on the crank axles must be applied from the bottom. For this reason, the cellar is made with a drop bottom and the pedestal binder is arched down at the center to allow for the easy renewal of the grease cake. The cellar forms a fixed spreader in the box to prevent any pinching of the sides of the driving box, and also serves as an additional support for the supplemented bearings.



The lateral motion device applied to the front and rear axles

With the exception that the locomotive has an additional pair of drivers, as compared with a 2-10-2 type, and three cylinders, which requires a crank axle on the No. 2 pair of drivers, the side rod design follows the usual practice, floating bushings being used on the main rod bearings. As shown in one of the drawings, the driving, engine truck and trailing truck springs are made with a reverse camber, which is also a standard of the Union Pacific.



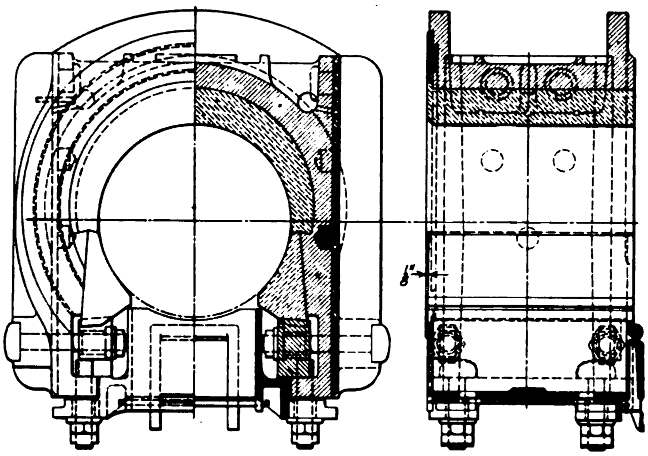
The engine truck details

The engine truck

One of the principal features in the design of the engine truck, shown in two of the illustrations, is the elimination of bolt fastenings. The frame is comprised of three steel castings, two journal box or side frame castings and a squaring frame. Equalization has been secured without the use of equalizers of the usual design. The pedestals have been designed to eliminate wearing

surfaces. Hinged lids are provided at the ends of the journal box castings, as shown in one of the illustrations, which permit the packing and lubricating of the cellars without necessitating their removal. The wheel base of 86 in. permits the use of long, flexible, easy riding springs. The journal bearings rest on a wedge similar to that used in tender journal boxes which insures an equalized journal bearing pressure over its entire surface.

The engine truck hub liners are made in two halves as shown in a drawing and in one of the photographs. The back of each half is provided with a tongue which slopes



Design cf driving box used on the main and crank axles

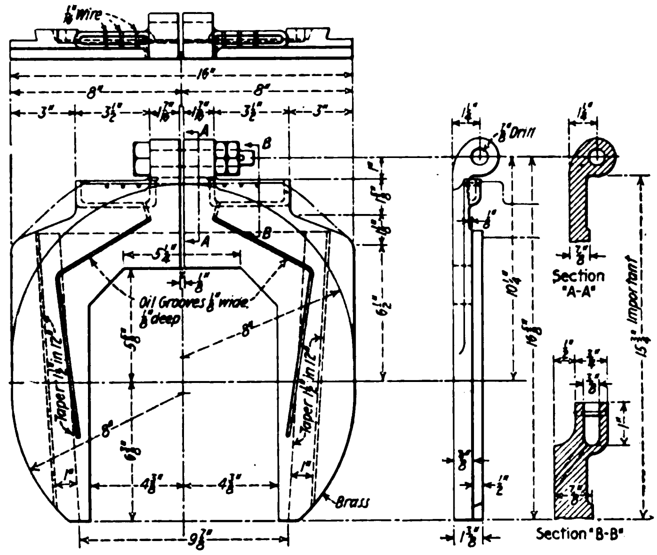
inwardly and down from the top, as shown in the drawing. These tongues dovetail into grooves on the face of the engine truck box which holds the hub liner in position. A bolt at the top secures the two halves together. When necessary to rebabbitt, the halves can be removed by taking out the bolt and can be reapplied without dismantling or removing the truck from the locomotive. Oil cavities are cast in the top half of each liner for lubricating the hub surface. These liners have been tried out on the engine trucks of a number of locomotives for a period of two years and have demonstrated their serviceability and utility from the standpoint of maintenance.

The centering device, shown in one of the engine truck illustrations, permits a swing of 6¼ in. to each side of center. Referring to the illustration, the rollers rest in the vees of the two blocks in the squaring frame casting and the vee block shown at the right sets on the rollers. Each of the two rollers is provided with gears which mesh with the gear teeth at the end of each vee. The latter extend only to the top of the vee which limits the amount of movement of the rollers. The center pin extends down through the vee blocks from the center casting to which the front equalizer is attached, the hole for which is shown in the drawing of the engine truck.

The boiler

The boiler is of the wagon top type and carries a pressure of 220 lb. per sq. in. The firebox total heating surface, including the combustion chamber, is 529 sq. ft. The heating surface of the five arch tubes is 62 sq. ft. making a total fire heating surface of 591 sq. ft. The area of the grates is 108.25 sq. ft. The boiler has 40 tubes, 3½ in. in diameter and 222 flues, also 3½ in. in diameter, with a length over the tube sheets of 22 ft. The total evaporating surface is 5,853 sq. ft. The boiler is equipped with a Type E superheater which provides a superheating surface of 2,560 sq. ft., and a Worthington feedwater heater having a capacity of 10,000 gal. per hour.

The design of the boiler presented a considerable problem. The builders were limited as to axle load and it was also desired to keep the total weight of the locomotive



Details of the engine truck hub liners

as low as possible. To secure a firebox to burn semi-bituminous coal it was necessary to have firebox volume combined with ample length of flameway and depth of firebox. Both volume and length of flameway were secured by a combination of Gaines wall and internal combustion chamber. Previous locomotives equipped with the Gaines wall never had sufficient depth from the crown to the top of the grate, but a satisfactory depth was obtained in this case by allowing the rear driving wheel to extend up between the inside of the throat and the front of

Comparative table of the principal dimensions, weights and proportions of the Union Pacific 2-8-8-0, 2-10-2, 4-10-2 and 4-12-2 type locomotives

Type	2-8-8-0	2-10-2	4-10-2	4-12-2
Cylinders, diameter and stroke	H.P. 26 in. by 32 in. L.P. 41 in. by 32 in.	29½ in. by 30 in.	2–25 in. by 30 in. 1–25 in. by 28 in.	2–27 in. by 32 in. 1–27 in. by 31 in.
Weight on drivers	465,000 lb.	285,500 lb.	288,500 lb.	355,000 lb.
Total weight of engine	495,500 lb.	357,600 lb.	405,000 lb.	495,000 lb.
Length, driving wheel base	15 ft. 6 in. 15 ft. 6 in.	22 ft. 6 in.	22 ft. 6 in.	30 ft. 8 in.
Diameter, driving wheels, outside tires	57 in.	63 in.	63 in.	67 in.
Boiler steam pressure	210 lb.	200 lb.	210 lb.	220 lb.
Grate area	88.1 sq. ft.	84 sq. ft.	84 sq. ft.	108.25 sq. ft.
Total evaporative heating surface	5,412 sq. ft.	5,152 sq. ft.	5,522 sq. ft.	5,853 sq. ft.
Comb. evaporative and superheating	6,809 sq. ft.	6,414 sq. ft.	6,897 sq. ft.	8,413 sq. ft.
Rated tractive force	Simple 123,700 lb. Compound 103,100 lb.	70,450 lb.	78,000 lb.	96,650 lb.
Cylinder horsepower (Cole)	....	3,136	3,547	4,329
Weight on drivers ÷ total weight engine, per cent	93.6	79.8	71.2	71.75
Weight on drivers ÷ tractive force	Simple 3.76 Compound 4.5	4.05	3.69	3.68
Tractive force ÷ comb. heat. surface	Simple 18.1 Compound 16.9	10.9	11.32	11.5
Cylinder hp. ÷ grate area	....	37	42.25	39.9

the Gaines wall. It was also desired to retain the same length of tubes, 22 ft., as used on the Union Pacific's other large locomotives, but while this seemingly gives a relatively short tube for a boiler of this size, the long distance from the front tube sheet to the cylinder center should in turn improve the draft conditions in the smoke box by equalizing the pull on the upper and lower flues. The

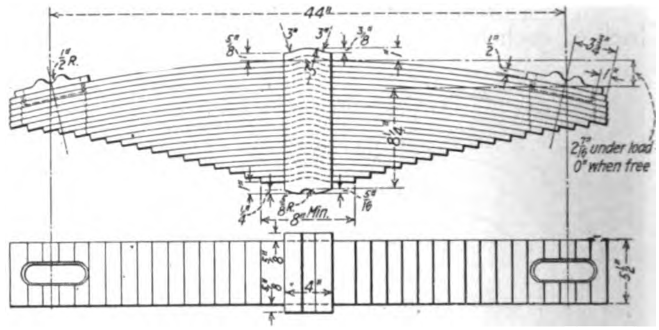
Table of dimensions, weights and proportions of the Union Pacific type locomotive

Railroad	Union Pacific
Builder	American Locomotive Co.
Type of locomotive	4-12-2
Service	Fast freight
Cylinders, diameter and stroke	2–27 in. by 32 in. 1–27 in. by 31 in.
Valve gear, type	Walschaert-Gresley
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1¼ in.
Exhaust clearance	1/16 in.
Lead in full gear	3/16 in.
Weights in working order:	
On drivers	355,000 lb.
On front truck	80,000 lb.
On trailing truck	60,000 lb.
Total engine	495,000 lb.
Tender	287,000 lb.
Wheel bases:	
Driving	30 ft. 8 in.
Rigid	17 ft. 6 in.
Total engine	52 ft. 4 in.
Total engine and tender	91 ft. 6½ in.
Wheels, diameter outside tires:	
Driving	67 in.
Front truck	30 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, numbers 2 and 3	12 in. by 13 in.
Driving, others	10 in. by 13 in.
Front truck	7½ in. by 13 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Wagon top
Steam pressure	220 lb.
Fuel	Semi-bituminous
Diameter, first ring, inside	90 in.
Combustion chamber, length	80½ in.
Tubes, number and diameter	40–3½ in.
Flues, number and diameter	222–3½ in.
Length over tube sheets	22 ft.
Grate area	108.25 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	529 sq. ft.
Arch tubes	62 sq. ft.
Tubes and flues	5,262 sq. ft.
Total evaporative	5,853 sq. ft.
Superheating	2,560 sq. ft.
Comb. evaporative and superheating	8,413 sq. ft.
Special equipment:	
Superheater	Type E
Feedwater heater	Worthington
Stoker	Elvin
Tender:	
Water capacity	15,000 gal.
Fuel capacity	42,000 lb.
Journals, diameter and length	6 in. by 11 in.
General data estimated:	
Rated tractive force	96,650 lb.
Cylinder horsepower (Cole)	4,329
Speed at 1,000 ft. piston speed	37.6 m.p.h.
Factor of adhesion	3.66
Curvature	16 deg.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cen.	71.75
Weight on drivers ÷ tractive force	3.68
Total weight engine ÷ cylinder hp	114.3
Total weight engine ÷ total heating surface	58.8
Boiler proportions:	
Comb. heating surface ÷ cylinder hp	1.95
Tractive force ÷ combined heat. surface	11.5
Tractive force × diam. drivers ÷ comb. heat. surface	769.7
Cylinder hp. ÷ grate area	39.9
Firebox heat. surface ÷ grate area	4.89
Firebox heat. surface, per cent of evap. heat. surface	6.28
Comb. heat. surface ÷ grate area	77.7

dome is the largest ever built by the American Locomotive Company and the firebox is the largest to which a Gaines wall has been applied.

The handrail post is the American Locomotive Company's standard design and utilizes but one stud to secure the post of the boiler and the cap to the post. This design permits the use of a single length of handrail post throughout the locomotive, since the handrail pipe is applied before the caps are fastened down. By removing the caps from two or more adjacent posts, the handrail posts may be removed without disturbing the hand rail itself and the boiler jacket raised for caulking the boiler. This is an improvement over the use of the solid handrail columns which required the removal of the entire handrail before a portion of the boiler jacket could be raised. Handrails used with this type of post are frequently utilized to carry the headlight or train control wiring.

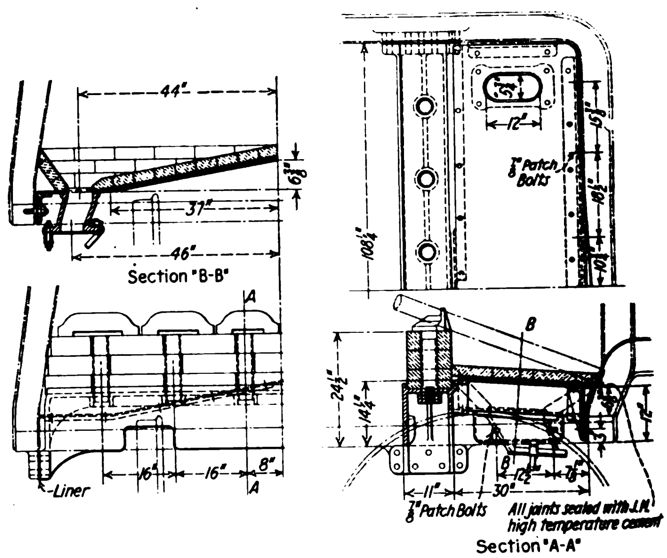
The air compressors are located at the front of the smoke box. This arrangement together with the con-



The driving, engine truck and trailing truck springs are made with a reverse camber

cealed piping gives the locomotive an unusually smooth appearance. The 67-in. drivers permit the use of a straight axle on the front drivers instead of a bent axle commonly applied to three-cylinder locomotives to clear the inside main rod. Other features in the design are the unusual length of the crown sheet, 241 11/16 in., and the saving in weight, approximately 5,000 lb., through the use of cast steel cylinders.

This locomotive was received on the rails of the Union Pacific on April 9, when it was immediately set up and

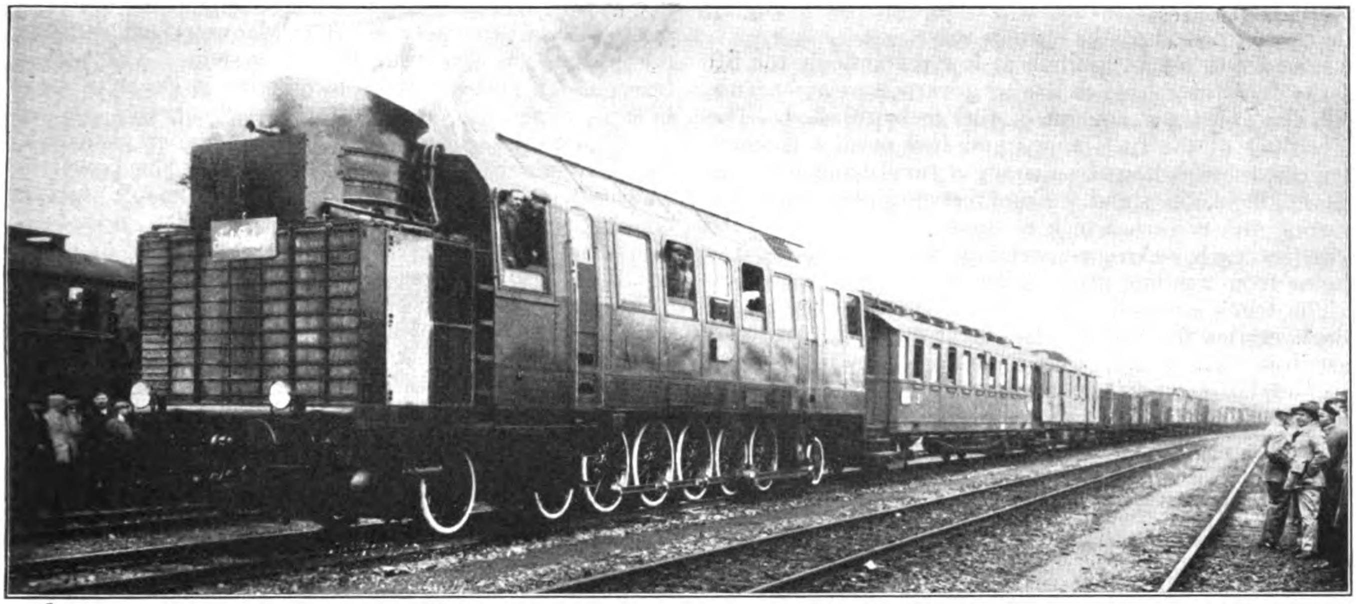


Arrangement of the Gaines wall in the firebox

placed in regular service. Since that time it has fully demonstrated that the traction, speed and fuel economy are in excess of the predicted characteristics calculated from the design.

The tender

The tender is carried on two six-wheel Commonwealth trucks equipped with 6-in. by 11-in. journals and 33-in. rolled steel wheels. It has a cylindrical tank of 15,000 gal. capacity. The capacity of the coal bunker is 42,000 lb.



The Russian Diesel locomotive, in service in Germany

Diesel locomotive with gear transmission

Electro-magnetically operated clutch system first applied to a Russian 1,200 hp. locomotive

By B. A. Wittkuhus, E.E., and N. Fodor, M. E.*

RECOGNITION is due to Prof. George Lomonossoff and Dipl. Ing. Dobrowolski, whose efforts made possible the building of the first two high powered Diesel locomotives, both for Russia, one already in service and the second recently finished.

The first Diesel electric locomotive, a 2-10-2 type, was equipped with a 1,200 b.hp. M.A.N. Diesel engine and has been in actual service for more than one year. The second Diesel locomotive is a 4-10-2 locomotive with gear transmission system and is also equipped with a 1,200 b.hp. M.A.N. Diesel engine. This locomotive was built by the Hohenzollern Locomotive Works at Duesseldorf, Germany, in collaboration with Prof. Lomonossoff and Magnet-Werk, Eisenach.

This locomotive is designed for freight service. It has the usual European plate frame upon which the Diesel engine is mounted. The castings carrying the Diesel engine serve also for stiffening the frame.

The weight of the locomotive in working order is 275,000 lb. The highest tractive force is 42,000 lb. at 4 m.p.h., and the maximum speed is 34.5 m.p.h.

The cooling system for the water and oil is placed at the front of the locomotive. It is of the fin tube type and is sufficiently large for operation in the warmer regions of Russia. The fan is driven by an auxiliary Diesel engine which is an M.A.N. airless injection, four cylinder, four cycle, single acting Diesel engine and develops 45 b.hp. at 1,000 r.p.m. Through a countershaft the engine also drives an electric generator for the clutches and lighting, and an auxiliary air compressor. The engineman's compartment is situated in this end of the cab. On both sides of the main engine, beneath the platforms, are the fuel oil tanks.

For heating purposes a small steam boiler is provided, which also utilizes the heat of the exhaust gases when the engine is running. The auxiliary cooling water and lubricating oil pumps are driven electrically. A set of storage batteries is placed above the leading truck. The locomotive is provided with Westinghouse brakes, and all necessary devices prescribed for its operation.

The main Diesel engine is of the six-cylinder, vertical, single acting, four cycle, air injection, direct reversible, M.A.N. submarine type and is made of cast steel. The engine develops 1,200 b.hp. at 450 r.p.m. with cylinders of 17¾ in. diameter and 16 9/16 in. stroke.

Two cylinders, each with a cast iron liner, are bolted to a common crank case casting which also carries the main bearings. The air compressors have an independent crank case. These crank case castings are bolted together, thereby forming a rigid girder. Two cooling water pumps and one oil pump for combined piston cooling and lubricating purposes are attached to and driven directly by the engine.

Each cylinder has an independent fuel pump, all of which are combined in a solid block in front of the air compressors. They are driven from the crankshaft. The governing of the fuel pumps and the output of the

* Mr. Wittkuhus is American representative of the Hohenzollern Locomotive Works, Duesseldorf, Germany, and of Magnet-Werk, Eisenach, Germany.

Diesel engine, respectively, is accomplished by changing the closing period of the suction valve.

In order to obtain ignition at low revolutions, the lift of the fuel valve needles is also governed in accordance with the speed and amount of fuel to be injected. The governing of the fuel pumps and fuel needles is interconnected and is done by turning a small hand wheel at the engineman's stand. Compressed air is used for starting the engine, which is done in groups of three cylinders each. An overspeed governor prevents the engine from running above 480 r.p.m.

The trunk piston is made in two parts. The upper which carries the piston rings is of steel, the lower of cast iron. The piston is oil cooled. The cylinder cover is of cast iron and is equipped with two fuel, one exhaust, one inlet, one starting and one safety valve. The exhaust valve is water cooled. Reversing is done by shifting the camshaft, thereby bringing new cams under the rollers, the reversing mechanism being hand driven. The engine has forced lubrication for all moving parts.

The exhaust gases escape through two long cylindrical silencers placed on the roof of the locomotive. This locomotive is the first to be equipped with a gear transmission system in which the speed stages are controlled by high power magnetic clutches. Not very long ago, no one would have believed that any type of friction clutch could transmit such high power as is used in this locomotive in a way reliable enough to warrant the use of clutches on locomotives. Only the recent development in the design and construction of high power electro-magnetically operated clutches made it possible to apply mechanical power transmission on high powered locomotives. The Magnet-Werk of Eisenach, Germany, has already built magnetic clutches for the transmission of more than 20,000 hp. per unit for the power plant of the Badenwerk, Germany, but the main magnetic clutch and the magnetic multiple disc clutches used on this locomotive were the first magetic clutches ever applied to locomotive service. The Magnet-Werk controls the patents on this transmission system. The power transmission system of the locomotive is clearly shown in Figs. 3 and 5.

Keyed to the backward extension of the crankshaft is the main magnetic clutch M (Fig. 5). The power is transmitted by this clutch and by a flexible spring clutch *b* to gears which are located in the gear box, also shown on Fig. 3. This box contains a set of gears for three different speeds and three magnetic clutches.

The main magnetic clutch is constructed of sufficient weight to act as a flywheel for the Diesel engine, and is shown on Fig. 4. It is of the single plate dry friction type but the design differs widely from other magnetic clutches. For the purpose of transmitting the maximum amount of power for its diameter and of giving the minimum wear, it is equipped with an exceptionally large friction lining of special unburnable material. The heat which is developed on the friction surface when the clutch is sliding is negligible and is carried off by the automatic air cooling system of the clutch consisting of radial air gaps between the body of the clutch and the friction plate. Special devices are provided for replacing the friction lining, making it possible to replace it in less than half an hour.

The clutch develops a maximum torque of 220,000 in.-lb. and can be regulated widely. This regulation is necessary at the starting of the locomotive as the clutch must be engaged at first at a low torque in order to avoid shocks when connecting the running Diesel engine with the driving wheels.

The coil of this clutch is specially wound to give high magnetic power with the minimum amount of electric current.

The body of the clutch is manufactured of special soft cast steel with a hysteresis curve which secures the

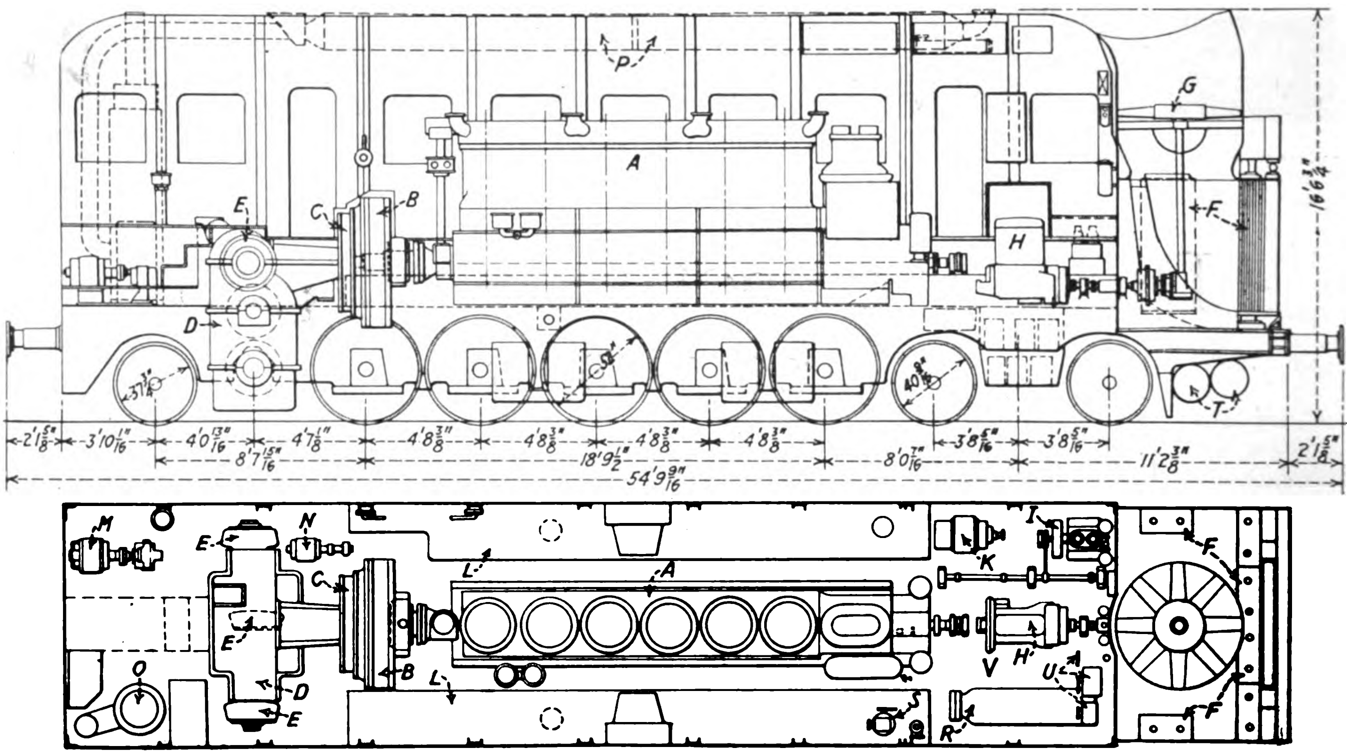


Fig. 2—Arrangement of equipment in the 1,200-hp. Diesel locomotive with mechanical transmission

A—Main Diesel engine; B—Main magnetic clutch; C—Spring coupling; D—Gear case; E—Magnetic multiple disc clutch; F—Coolers; G—Fan; H—Auxiliary Diesel engine; I—Auxiliary air compressor; K—Electric generator; L—Fuel oil tank; M—Auxiliary cooling water pump; N—Auxiliary lubricating oil pump; O—Heating boiler; P—Exhaust silencer; R—Starting air bottle; S—Injection air bottle; T—Air tank for brakes; U—Control devices; V—Engineman's stand.

possibility of gradually increasing the torque when the current is switched on. Further means of regulating the torque are provided by special resistors in the electric circuit of the coil. The torque automatically increases gradually and the clutch slides for a few seconds, thus accelerating the locomotive very smoothly in a relatively short time. The tests on the tracks proved that while starting a 1,500-ton train on a grade of 1.2 per cent, the main clutch slid only 10 to 12 seconds.

The spring coupling is a product of the Fried. Krupp, A. G., Essen, Germany. Its duty consists mainly in equalizing the variable torques of the Diesel engine. This coupling accomplishes its duty so well that the torque at the end of this coupling is very uniform.

The gear system, consisting of a pair of bevel gears and several spur gears, was supplied by the Fried. Krupp, A. G. The gears are of high quality alloy steel, ground and hardened. The shafts are of the best special steel, hardened and accurately ground. The quality of the workmanship in the manufacture of these gears results in an exceptionally low starting resistance and friction loss. An efficiency as high as 93 per cent has been obtained on the test bed with these gears from main clutch to jack-shaft.

The teeth of the gears and the bearings are force-lubricated. The whole system being enclosed in an oil tight and dust proof housing also containing the jack-shaft.

The three speed-stages are controlled by three high powered magnetic clutches, one for each stage. The changing of speed is accomplished merely by engaging and disengaging the clutches, so that the gears are always in mesh, thus lessening the wear of the gears.

These clutches are the most essential part of the whole locomotive and only after years of special experimental and research work, has it been possible for the Magnet-Werk to design these clutches which had to be exceptionally powerful and could not occupy more space and weight than a clutch which, when constructed in the usual way, only transmits about one-tenth of the power of these special magnetic clutches. Their torque is only slightly smaller than the power of the main magnetic clutch but the space occupied by them and their weight is only a fraction of that of the main magnetic clutch.

All three are of uniform size and of the multiple disc, dry friction type and are shown on Fig. 6.

These clutches will probably never need any adjustment or replacement of friction linings as they practically never slide and therefore have no wear. They have been constructed to engage instantly after the current is switched on. The consumption of electric current by the clutches is very small and does not exceed 1.3 kw., including the main clutch. Only one of the multiple disc clutches and the main clutch are engaged at the same time, the other two being idle.

The total weight of the gears, clutches, jackshaft and housing is 30,800 lb. The gear system has the following ratios:

Through clutch I and gears 1, 2, 3, 4 the ratio is 1:7.
Through clutch II and gears 5, 6, 3, 4 the ratio is 1:4.
Through clutch III and gears 7, 8, 3, 4 the ration is 1:2.

In addition to these gear ratios, the revolutions of the Diesel engine can be changed to such an extent that the revolutions of the driving wheels vary between 14.5 and 225 r.p.m., corresponding to a speed of from 2.25 to 34.5 m.p.h. The reversing of the locomotive is accomplished by reversing the Diesel engine.

There is one control-lever for the Diesel engine, one controller of the drum type for the main clutch and one similar controller for the three multiple disc clutches, the lever of this latter controller having three positions for the three speeds. The operation of the locomotive is accomplished as follows:

After starting the Diesel engine and accelerating it to its idling speed, the engineman engages clutch I by moving the control lever to the position for speed I. Upon receipt of the starting signal, he engages the main clutch *M* gradually by means of the main controller. After a few seconds, during which the main clutch slides, the train starts to move and accelerates. Further accelerating is made by speeding up the Diesel engine to its maximum revolutions. As soon as this point is reached, the engineman removes the lever of the controller for the three multiple disc clutches to the position of the second speed, thus disengaging clutch I and engaging clutch II. Automatically, by moving the lever, the torque of the main clutch is decreased for a few seconds by varying the resistance of its electric circuit

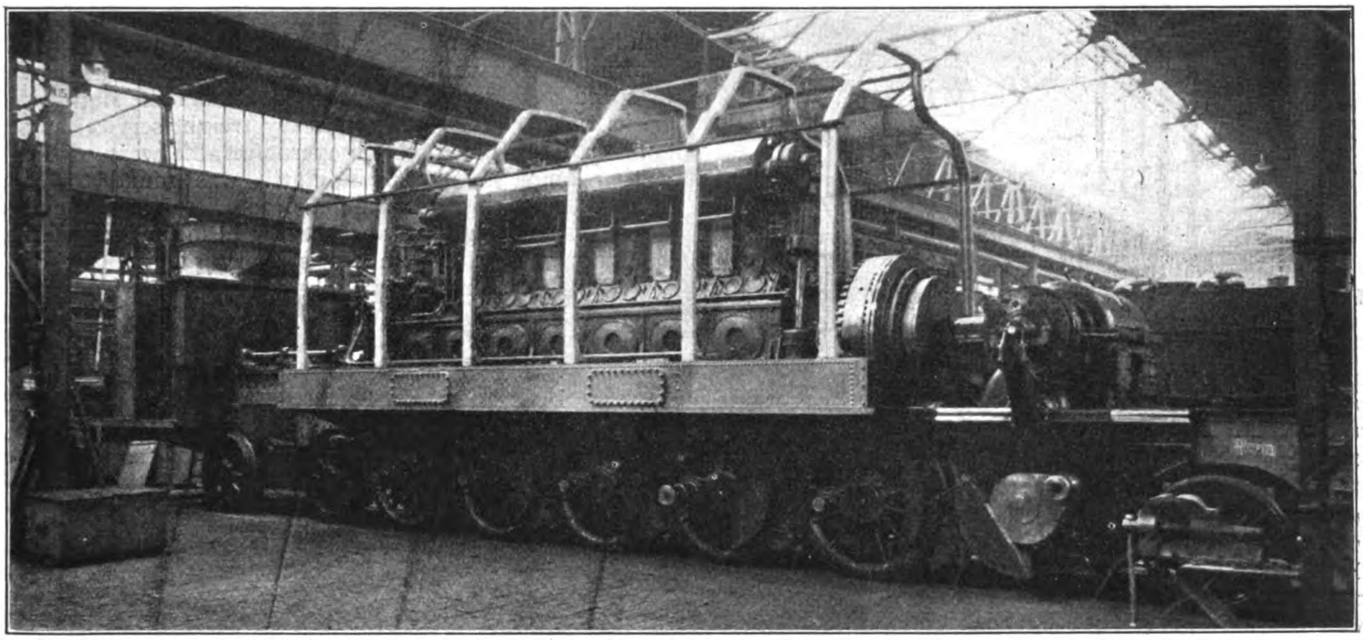


Fig. 3—The 1,200 hp. Diesel locomotive without the cab, showing the mechanical transmission at the right

thus enabling the main clutch to slide for a short time if the respective speeds of Diesel engine and gears do not correspond exactly. After changing the speed, the Diesel engine which has been slowed down, is again accelerated, and the same operations are repeated for changing to the third speed.

In this locomotive the three different control levers have been provided to permit a study of the relations between the three different controls, with the ultimate purpose of designing a simplified one-hand control with which a locomotive of this type will be equipped.

The Diesel locomotive with gear transmission system maintained a brake thermal efficiency from 30 to 31 per cent. This is 20 per cent more than the efficiency of the 1,200 hp. Diesel electric locomotive. It is to be borne in mind that the geared-driven Diesel locomotive operates

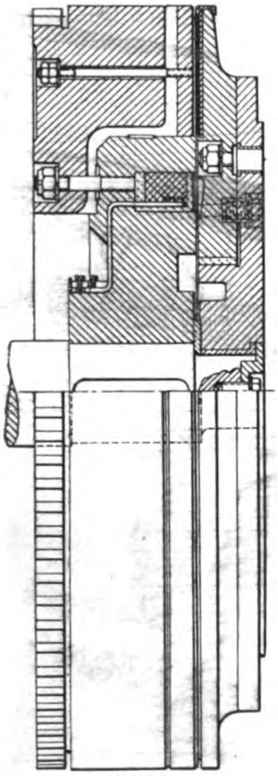


FIG. 4

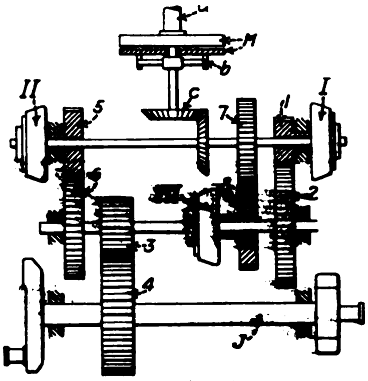


FIG. 5

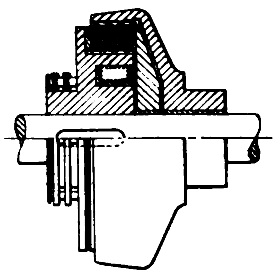


FIG. 6

Fig. 4—The main magnetic MWE clutch; Fig. 5—Scheme of the clutch and gear transmission system; Fig. 6—Magnetic MWE multiple disc clutch

with this high efficiency almost on its entire power range, while the steam locomotive maintains its maximum efficiency during limited periods only.

Fig. 7 shows that the same Diesel locomotive if equipped with four proper speed stages can be used easily for freight or switching and passenger service. Neither an electric locomotive nor the other existing transmission systems can render the same kind of railway service. By simply varying the gear ratios, the tractive efforts and speeds can be easily adjusted to different conditions.

We wish to mention a few advantages of the geared Diesel locomotive. The passenger locomotive having a high tractive force first stage gear can be used for terminal switching service also, thereby eliminating special switching locomotives. This same locomotive, on account of the high tractive force of the first two stages can be advantageously used for freight service, the remaining speed stages being arranged for high speed passenger service.

The possibility of thus using one Diesel locomotive for different purposes will result in reduction in the number of locomotive types, standardization of locomotives and Diesel engines on a large scale, and lessening the cost of operation, maintenance, and production.

The design of the locomotive also makes possible the arrangement of multiple unit control.

Doubts may arise regarding the smooth starting and acceleration as well as the flexibility of a Diesel locomotive employing a gear transmission system.

The locomotive has been subjected to thorough and extended tests on the locomotive testing plant in Dusseldorf. Since May 1 it has also undergone tests on the tracks of the German State Railways.

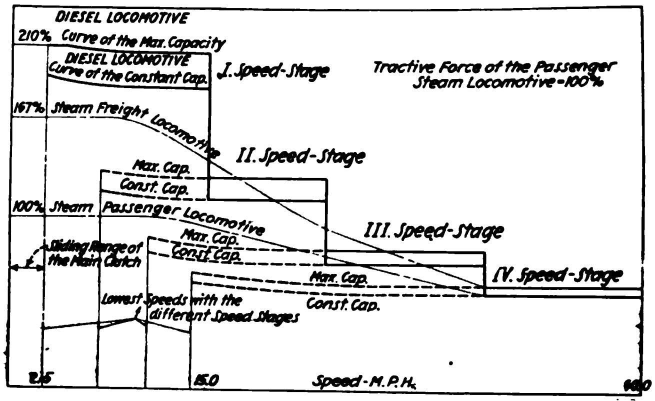
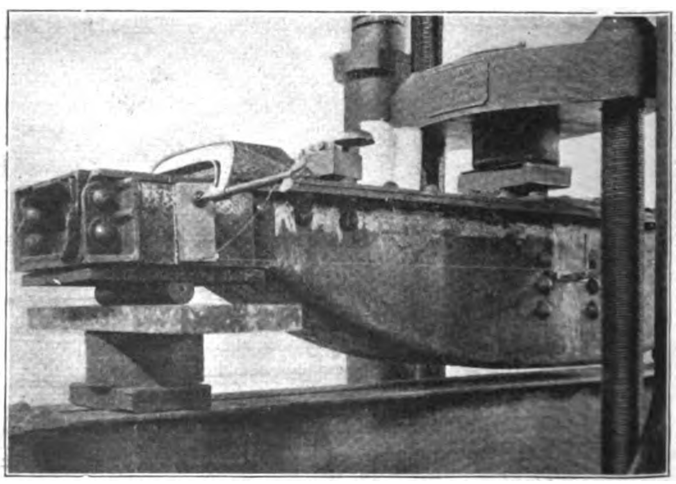
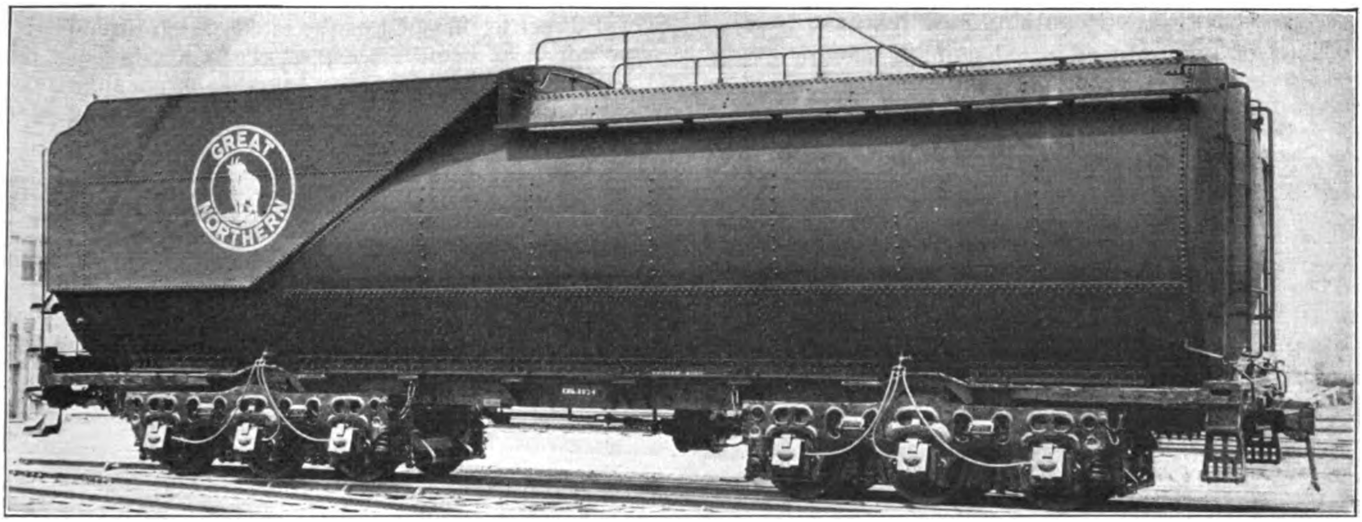


Fig. 7—Comparison of the form of characteristic curves of steam and Diesel locomotives, the latter with a four-speed mechanical transmission

It has been ascertained during these tests that the locomotive starts smoother than a steam locomotive, even with heavy trains on grades. The control of the clutches as mentioned above has proved entirely satisfactory and the speed changes are accomplished without the slightest shocks. After 2,600 miles in heavy freight service, and more than 1,000 main clutch operations, the wear of the friction lining of the main clutch was found to be .011 in. Thus with a variable speed Diesel engine and properly selected gear ratios, the Diesel locomotive with gear transmission system meets every requirement of flexibility in modern railway service.



Bending tests of a pressed steel car truck bolster on a 300,000 lb. capacity Riehle machine at Purdue University



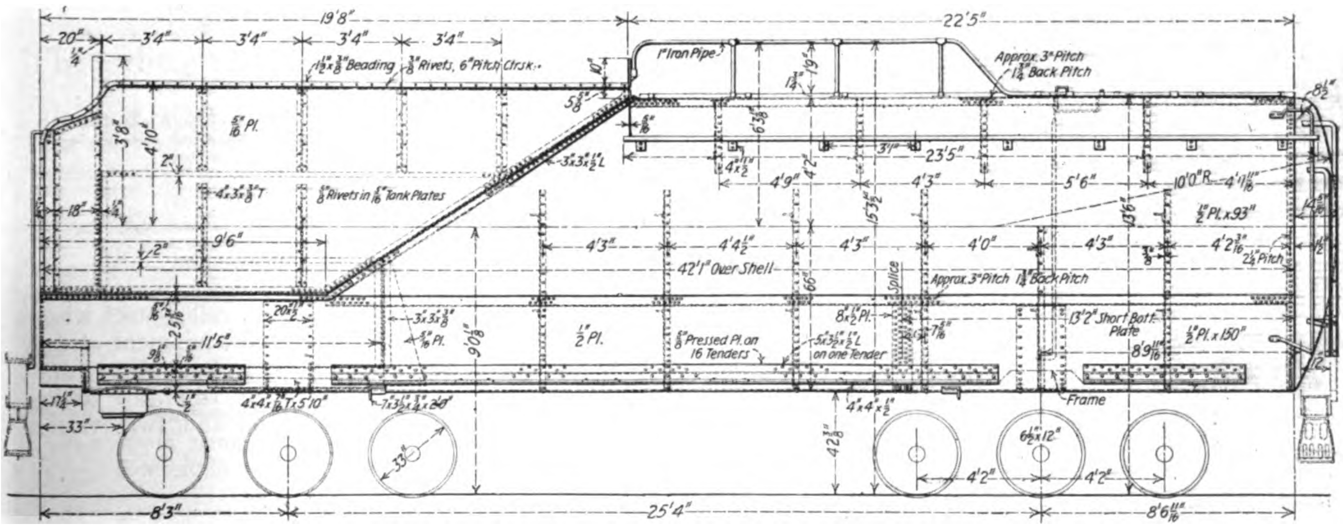
Vanderbilt type tender built for the Great Northern by the General American Car Company

Tenders of large capacity for the Great Northern

Rigid anchorage between body and underframe—Capacity 24 tons of coal, 21,500 gal. of water

THE General American Car Company, Chicago, is delivering an order of 17 locomotive tenders to the Great Northern which are the largest that have ever been built for regular railroad service. These tenders have a coal capacity of 24 tons and a water capacity of 21,500 gal. The light weight is 138,100 lb. and the weight when loaded is 364,550 lb., or 182 tons. The length over the striking castings is 44 ft. 7⅝ in., and the distance between truck centers, 25 ft. 4 in.

These tenders are the result of extensive studies made by the management of the Great Northern of its operating problems with the object of obtaining more efficient operation, especially on grades over the Rocky Mountains, and the purchase of these tenders is an interesting development not only in the type of tender construction, but also in the procurement of increased operating efficiency for heavy tonnage trains. The introduction of large capacity tenders will make possible considerable reduction in operating time and costs and also permit closer adherence to schedules. Many stops for fuel and water can be eliminated, thus permitting heavy trains to make continuous hauls over difficult divisions. Stopping trains shortly before reaching a water tank or fuel station, uncoupling the locomotive, filling, returning to the train, coupling and testing the air before proceeding, takes considerable time. The elimination of such stops, of course, enables a train to get over the road much faster and with fewer interruptions to it and following trains.



Elevation drawing of the Great Northern locomotive tender

Construction contains new features

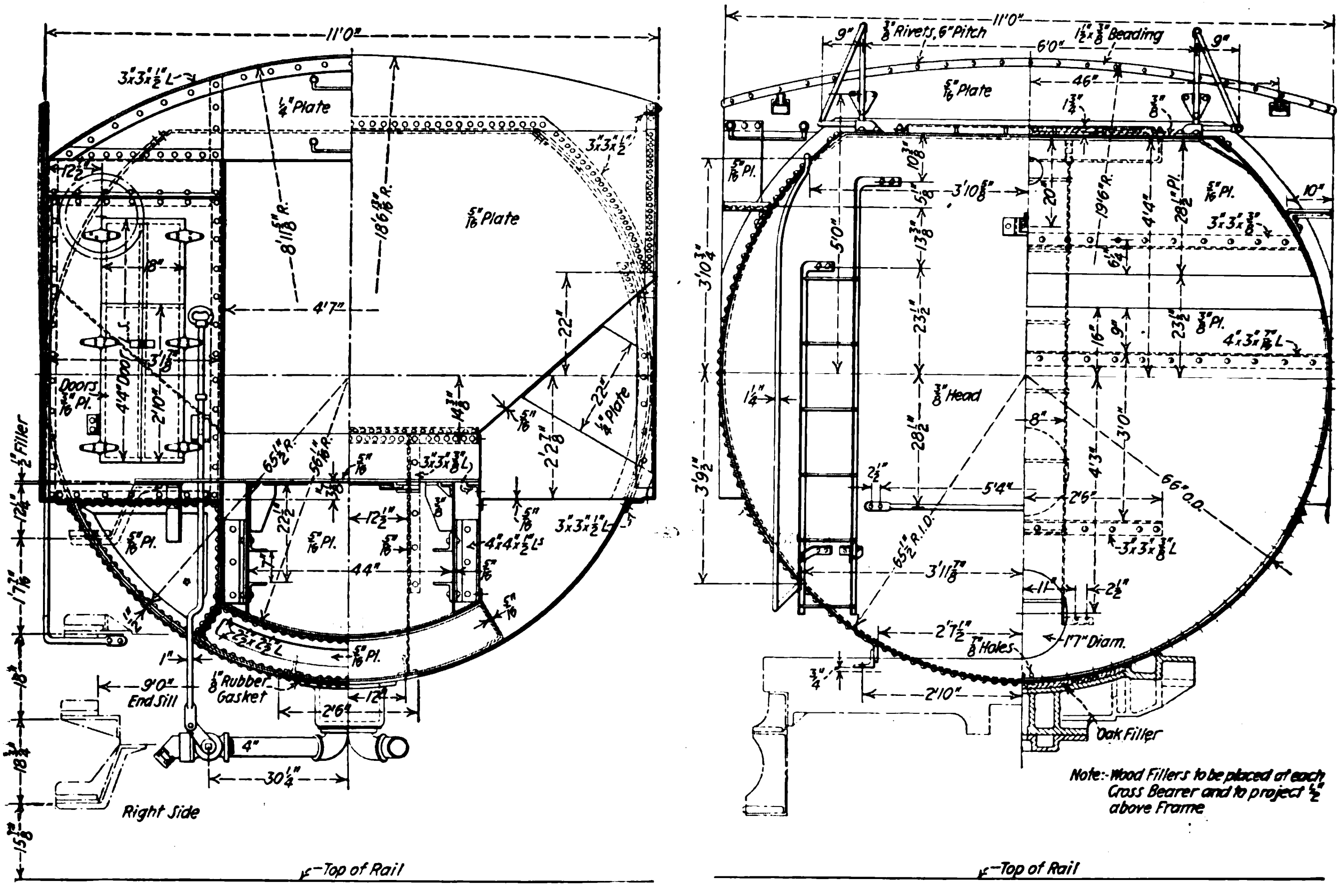
Some of the features included in the design of the tenders are the result of developments that have been successfully used in tank car construction for a number of years. The engineering department of the General American Car Company, which has had considerable experience as designers and builders of large tank cars, was able to render valuable assistance to the mechanical department of the railroad in developing the design of these tenders.

A feature in the design is the use of the General American type of rigid anchorage between the tender body and the cast steel underframe. This is a patented device for use in tanks for transporting liquids and has proved quite satisfactory after many years' service. It consists of a longitudinal angle riveted to the tank body with the other flange punched to register with another angle, one flange of which is riveted to the angle on the tank and the other flange bolted to anchorage pads cast in the underframe. This anchorage runs practically the entire length of the tank on each side and permits a wide distribution of the stresses incident to operation and end shocks. It is also located for ease in application, inspection and maintenance, permitting the anchorage bolts to be kept tight at all times with the minimum amount of labor.

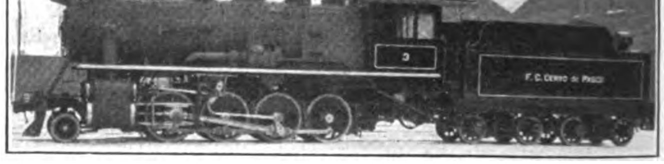
Previous practice on this type of tender tank has been to rivet the anchorage castings on the tank, which fitted on pads cast on the underframe, several pads being distributed along the side of the tank, but this set up localized stresses and sometimes resulted in buckling the plates to which they were attached.

Referring to the elevation and cross section drawings, it will be seen that the tank is provided with six baffle or surge plates, the edges of which are flanged and riveted direct to the shell of the tank. Each baffle plate has a 1-ft. 7-in. diameter hole on the center line and is strengthened with a 3-in. by 3-in. by 3/8-in. angle, as shown in the cross section drawings. The holes in adjacent baffle plates are placed in vertically staggered position to each other. In addition to the bracing provided by the baffle plates, the top portion of the shell is braced with 3/8-in. plates and angles as shown in the elevation drawing.

The height from the rail to the top of the hand rail is 15 ft. 4½ in., to the top of the running board 13 ft. 4 in., and 9 ft. 3/8 in. to the horizontal center line of the tank. The underframe is a single steel casting, designed and cast by the Commonwealth Steel Company, St. Louis, Mo. The six-wheel truck frames are of the Commonwealth cast steel integral pedestal type, equipped with 6½-in. by 12-in. journals, 33-in. rolled steel wheels and clasp brakes. Besides the special equipment already mentioned, the tender is equipped with a Miner draft gear, friction side bearings, 12-in. by 18-in. air brakes, Imperial type A uncoupling device and two vertical built-in tool boxes.



Cross section drawings showing the design of baffle plates and bracing used in the construction



2-8-0 locomotive built for the Cerro de Pasco railroad, Peru, by the American Locomotive Company

Report of the air brake convention

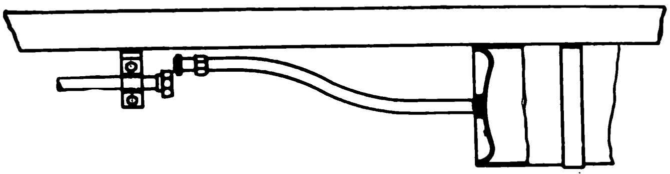
Papers on insulating air compressors, air brake hose coupling gages and threading and bending air brake pipes

A BRIEF account of the proceedings of the opening sessions of the thirty-third annual convention of the Air Brake Association, which was held at the Hotel Roosevelt, New Orleans, La., on May 4 to 7, inclusive, appeared on page 374 in the June issue. Before the close of the convention, the association voted to hold its 1927 convention at Washington, D. C.

In the following pages will be found abstracts of two reports and one paper, most of which have an important bearing on the maintenance of air brake equipment.

Threading and bending of air brake pipes

It must be borne in mind that as wrought iron pipe has been selected for air brake service because it has better welding quality, better threading quality, superior resistance to corrosion, and especially its superior resistance to shock and vibration, certain limitations of the material, or points of difference in comparison with steel, must be given consideration in its use. Some of these more important points are considered below.



An example of poor alignment of pipe in fitting which results in a strain being placed on the threads of the reservoir connection when the pipe is sprung into place

Methods of bending pipe

In making a bend, there is stretching of the metal on the outer circumference of the bend, and a tendency for compression on the inner circle. A neutral circle, or axis where no elongation or contraction takes place, lies somewhere between the inner and outer circles. Experience indicates that in cold bending, the neutral axis lies close to the inner circle; in other words, practically all of the metal is stretched, with greatest amount of stretch on the outer circle; and consequently almost all of the pipe wall is thinned to a greater or less degree. In hot bending, the neutral axis appears to be somewhat closer to the inner circle than to the outer; ordinarily about one-third of the distance out from the inner circle. Thus for hot bends, the inner one-third of a pipe wall is thickened; while the outer two-thirds are stretched and thinned.

The ability to make a bend, other things being equal, depends upon the ability of the pipe metal to stretch. For any given size of pipe, the ratio of stretch required to complete the bend increases as the radius of the bend decreases. For a fixed radius of bend, the outer stretch is more severe as the diameter of pipe increases. Hot bends can be made to shorter radii than cold bends; this is because the ductility of the metal is greater when hot than when cold; also because the neutral axis is farther out and the total stretch around the outer curve is therefore less.

If pipe is permitted to flatten or collapse during bending, the outer circumference is lessened, and the bend is more safely made. On this account, the sand filled bend puts more strain on the metal than one made without filling. Of course, sand filling results in a superior type of bend, and one retaining the full pipe bore.

Extra heavy pipe is preferable to standard weight for bending, because when stretching takes place, the pipe wall does not so soon reach a thinning to the danger point of tearing; also there is more effective wall thickness left for service.

To make short radius bends, the closest attention must be given to all details. Proper workmanship is as important as quality of material, for poor workmanship can spoil good as well as poor pipe.

Since the best of practice does subject the larger portion of the metal to a stretch, the method should so far

as possible distribute this elongation evenly over the entire section which is bent.

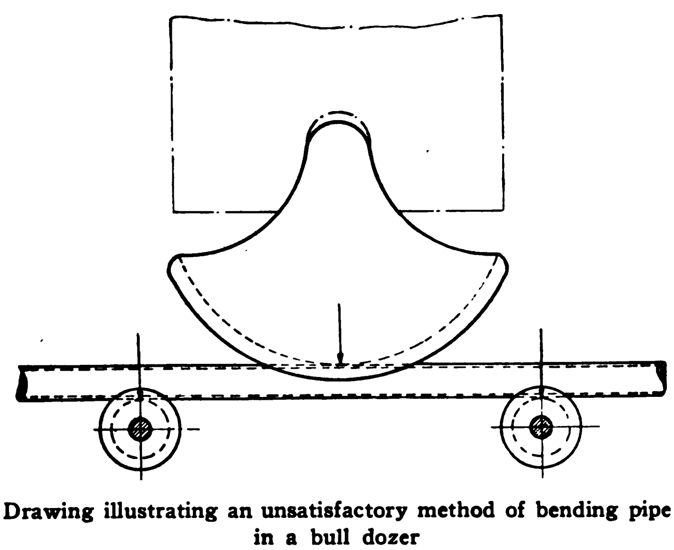
Wrought iron cannot be bent to as short radii as steel pipe; however there is always a greater tendency of the steel pipe to split at the weld, which frequently does not appear until after it is in service. This is merely a reflection of the fact that wrought iron does not have as much ductility as steel. Standard specifications of the two materials require a minimum ductility of twelve per cent for wrought iron pipe, compared to eighteen per cent for steel pipe, in a gage length of eight inches.

Experience has shown that a good grade of wrought iron pipe may be safely stretched cold twenty to twenty-five per cent in each one-inch zone. Consequently for average grade of material and good practice, cold bends without sand filling may be made with extra heavy wrought iron pipe to a radius of three times the outside diameter of the pipe.

For hot bends, double the cold strength above noted may be safely reached in each one-inch section, before tearing occurs. Consequently unfilled hot bends may be made with extra heavy wrought iron pipe to a radius of one and one-half times the outside diameter of the pipe.

If tearing occurs in making certain bends, it is well to check the amount of stretch and its uniformity by prick punching the unbent pipe at one-inch intervals along the line of the outer circumference of the bend. After bending, the elongation in the individual inches may be measured with a flexible scale. It is not unusual to find that bends which apparently should not tax the pipe severely, are up to or exceeding the danger limits in certain sections of the bend, due to faulty practice. It is obvious that uniformly distributed stretch is an important factor in making short radius bends.

In hot bending, it is exceedingly important to get the proper temperatures. Maximum ductility is reached at about 1,500 deg. F. (a cherry red heat). This temperature should not be exceeded, because the ductility of the

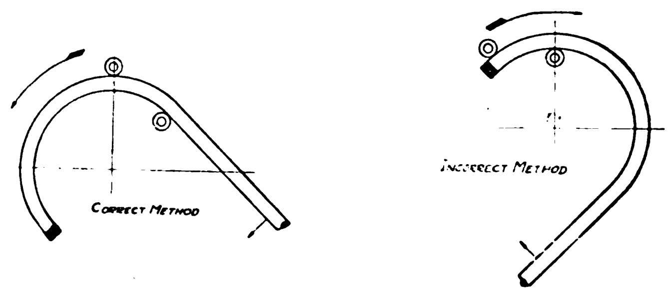


Drawing illustrating an unsatisfactory method of bending pipe in a bull dozer

wrought iron falls off rapidly with further increase of temperature. Also because there is a peculiar condition of relative strength which causes an abnormal condition in stretching. It is equally important to heat the pipe uniformly to the proper temperature over the entire zone covering the complete bend.

Conditions and practice for hot bending must be more carefully controlled than for cold bends, because of (1) the ease with which more than normal distortion may be accomplished; (2) the adverse influence of uneven heating; and (3) the absence of the compensating effect of cold overstrain, which tends to shift the stretch to adjoining less elongated zones in cold bending.

Next to heating, the bending machine or practice is important. The stretch should be applied to a small local section of the bend, and then by proper functioning of machine or practice this stretched zone should be advanced out of the sphere of action and a new adjoining section subjected to the bending force. Forcibly pulling a clamped pipe around a sheave or pin, or pushing it into form in a bulldozer, represents probably the poorest method and puts the most severe strain on the pipe. The general method of using the bulldozer type of bending is



Correct and incorrect method of bending pipe

illustrated. Where the die presses against the pipe, in making the bend, a binding action occurs at both pins or rollers; this binding or pinching action becomes more pronounced if the rollers fit the pipe poorly or are not free to rotate. Because of this the pipe is not free to movement and there is always a strong tendency to localize the stretch of bending in the portion of the pipe between the rollers. Careful or skillful hand bending, or proper construction of machines, work towards the desired end.

Slow pulling of the bend is of considerable advantage. The fabricators, who regularly obtain good results, with wrought iron, employ machines which progressively advance the bent section, and subject the following unbent portions to the forming action and without further strain upon the bent section. In some hot bending cases a stream of water is applied to the outside circumference in the zone of progressive bending. This stiffens the already stretched metal, concentrates the stretch on the following hot and unbent portions of the pipe, reduces collapsing, and tends in some degree to bring compression on the inner circumference more into play in formation of the bend. This practice is not recommended except with most skilled operators, and best of machines and practice.

More difficulty will be encountered in bending galvanized pipe than for similar work on black pipe. This usually is confined to outcropping of trouble in occasional pieces, and is probably due to some embrittling influence of pickling.

The position of the weld in bending is usually a cause for argument. With highest quality of welds, this matter is of relatively small amount. In general, it is advisable to have the weld on the outer circumference. This is particularly true for butt-welded pipe; and the same rule is not out of place for lap-welded pipe.

While the points outlined above apply to bending practice in general, many of the cautions are especially applicable to short radius bends. Too much stress cannot be laid upon the advisability of avoiding short radius bends as far as possible; and it is believed that in railroad service, half to three-fourths of the customary short bends may be eliminated. The shorter the radius of the bends, the greater the proportionate stretching. Many extra

heavy pipe installations are actually of less than standard weight thickness in the close bend section.

It hardly seems necessary to stress the often repeated warning to thoroughly clean out piping before installation, especially after undergoing a bending operation. Nevertheless we are all aware of the fact that this is too often neglected, not only by the railroad shops but also by the builders in turning out new equipment. This neglect invariably leads to additional expense caused by the necessity of removing valve devices for supplementary cleaning and for carrying out the belated cleaning of the piping, when the rolling stock is first received from the shop doing such work.

Accurate smooth threads essential

In order to insure a good tight joint between the pipe and fittings, it is necessary to have a clean smooth cut thread of the proper shape and taper; and to secure such a thread, it is necessary to keep dies and machinery which do this work in proper condition.

In the use of hand-tools, and especially the narrow receding chaser types of today, it is very important that the die stock be clamped to the pipe securely in order to obtain good results. A small wrench or plyers should be used upon the thumb screws.

Wavy threads are very often the result of not having the die stock securely tightened to the body of the pipe. Also while a very good appearing thread may be obtained, it is possible that the threaded end may not be perfectly round, thereby causing a leak when screwed into a fitting, and especially so when used in connection with air brake piping.

It is very important that the thread on the pipe be long enough to insure a full engagement of pipe and fitting. If full engagement is not obtained, loose or leaky joints are apt to result; and more than that, vibrational stresses, instead of being distributed over the entire thread bearing, are localized in the two or three engaged threads, which frequently result in premature failures.

In this connection, it should be remarked that the fitting is frequently improperly tapped and will not permit of a full thread engagement. When a fitting of this kind is encountered, it should either be retapped or scrapped. There is no excuse for supply concerns furnishing such fittings, because pipe threads are standardized with definite allowable tolerances both for the pipe and the fitting. These tolerances are so designed that the maximum of one ought to properly make up with the minimum of the other, and when this cannot be done with a properly threaded pipe, the fitting is non-standard and should not be used.

Of all the economic crimes committed by pipe fitters, that of straining into position pipes that must come together but through faulty practice are not properly fitted, is the most common and the most expensive. Pipe may be well bent and threaded, and joints carefully made, with little assurance of long life if an initial strain is thus needlessly placed on the threads of some connection. Inspectors should be instructed to break a union here and there on new work, and if the pipe springs to one side, they should refuse to approve the job until the pipe is correctly fitted. This will save a lot of money.

The general features brought out in this paper are an endeavor to briefly convey suggestions of the best practices to get the greatest efficiency in pipe installations. There are limits beyond which material cannot be safely used. Good workmanship in fabrication is an important factor in getting the maximum out of any pipe. In railroad service, in particular, initial stresses set up by straining joints into place due to faulty alinement, improper bending, or poor threading, will accelerate fatigue failures and reduce the normal margin of safety in train operation.

(*This paper was contributed by the Pittsburgh Air Brake Club.*)

Air brake hose coupling gages

A major portion of brake pipe leakage is due to hose couplings. The Committee on Air Brake Hose Couplings has made a number of tests on eastern and western railroads and finds the present standard A. R. A. gages are not applicable for removing couplings that are not fit for service. In a large number of cases, couplings that pass the present standard A. R. A. gages could not be made tight under pressure after the renewal of gaskets.

The following information developed:

Forty-seven per cent of the couplings examined were found to have the diameter of the hole too small to admit

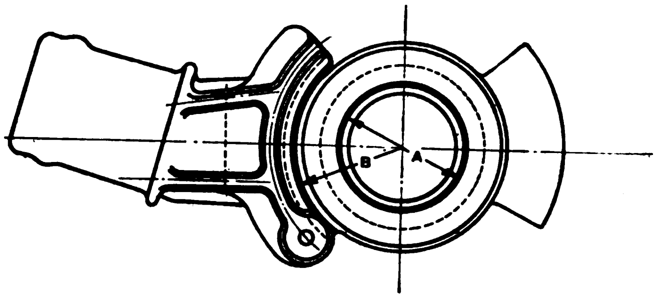


Fig. 1

the application of a standard A. R. A. gasket properly, as shown in Fig. 1, dimension *A*.

Sixty-eight per cent of the couplings examined showed that there was a variation in distance from the center of the bore to the outer edge of the guard arm from 1/32 in. to ⅛ in., resulting in the impossibility of proper alinement of two couplings, as shown in Fig. 1, dimension *B*.

Forty-one per cent of the couplings examined showed that there was a variation in the distance of the top face of the gasket groove from the face of the coupler, as shown in Fig. 2, dimension *C*.

Eighty-six per cent of the couplings examined showed

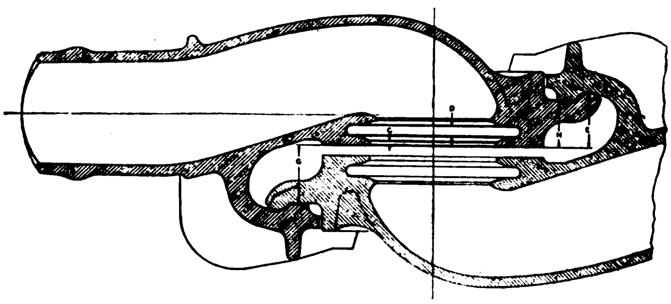


Fig. 2

that the gasket grooves were not in accordance with A. R. A. standards; there being a considerable variation below the minimum and above the maximum allowed, as shown in Fig. 2, dimension *D*.

Forty-three per cent of the couplings examined showed a variation in the bend of the lip of the coupling. The height of this bend is important in order to permit the coupling to come in contact with the flat bearing face on lip and guard arm, in order to produce the proper amount

of resistance in the coupling against pulling apart, as shown in Fig. 2, dimension *E*.

Seventy-one per cent of the couplings examined showed that there was a variation in the contour of the body of the coupling. This contour acts as a guide when coupling the heads, and insures proper alinement of the gaskets.

Fifty-seven per cent of the couplings examined showed that there was a variation in the grooves and flat spots on the guard arm as shown in Fig. 2, dimension *G*.

Fifty-four per cent of the couplings examined showed that there was a variation between the face of the coupling and the flat bearing face of the lip. This distance controls the compression to which the gaskets are subjected, when the couplers are coupled, as shown in Fig. 2, dimension *H*.

On account of the wide variations from permissible tolerances of couplings, as made by various manufacturers, and further, realizing the inadequacy of the present A. R. A. gages, your committee feels that improvement of the gages is necessary, and that closer inspection by manufacturers and railroads should be insisted on. Since the angle cock is the greatest offender in producing brake pipe leakage, and is closely seconded by the coupling, any efforts to reduce the leakage from these points is well worth while.

(The report of the committee was signed by Chairman R. M. Long (P. & L. E.), L. G. Plank (Penna.), W. Shriver (B. & O.), J. P. Stewart (M. P.), and J. H. Glenn (P. & W. Va.),

Insulation of air compressor steam cylinders

By C. B. Miles

New York Air Brake Company, Omaha, Neb.

At the Los Angeles convention, in the concluding paragraphs of the paper on "More Efficient Air Compressors" we called attention to the unnecessary waste of energy through the exposed walls and heads of the steam cylinders of locomotive air compressors. At that time we had in mind running a test to measure this loss, but a change of position prevented our pursuing this interesting problem to a conclusion. It is obvious to the student of air brake problems that this heat waste can be materially reduced by insulating the cylinder surfaces in a more complete manner than is done at present.

The walls and heads of the 8½ in. 150 cu. ft. compressor represent in excess of 3,400 sq. in. of radiating surface, a part of which, about 38 per cent, is covered with sheet metal and generally a wooden lagging. It appears very important to pay attention to radiation losses where steam is being used expansively, as is the case with this type of compressor. In the second stage, or low pressure cylinder, there is a definite measure of steam at reduced temperature to do a certain amount of work. As much of this energy as possible should be used to propel the piston, rather than lose itself through the walls and heads of the cylinder.

If the piston speed is high there are more measures of steam to suffer loss. If the speed is reduced, the time element comes in, and it is problematical, under certain conditions, as to whether the piston makes a full stroke or not.

This compressor is properly designed for economical operation, but the steam cylinders cannot be water jacketed and expect the best performance which we are just about doing when we are fanning these exposed surfaces with the equivalent of a 60 mile an hour zero breeze.

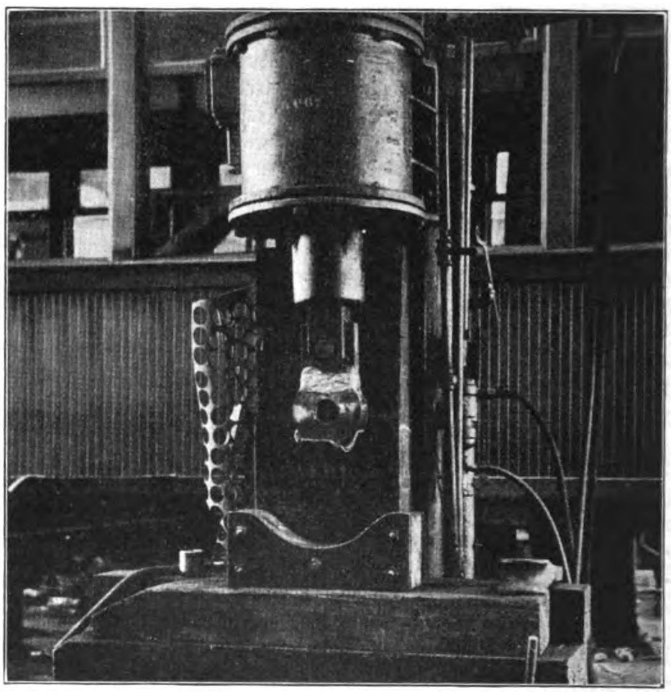
If the regular service efficiency could be increased five per cent we would be the gainer just that per cent of the cost of whatever amount of compressed air is necessary. The average one thousand engined railroad could take the $10,000 saved from that source and reduce their $200,000 brake system leakage cost to $66,000 (which is the mark the Brake System Leakage Committee sets up for us to hit), with the expenses of a well equipped air brake supervisory organization paid for in advance.

The Union Pacific through the interest taken in this subject by O. S. Jackson, superintendent, motive power and machinery, have made some preliminary tests, to which they attach sufficient importance to have more thoroughly covered the steam cylinders on compressors on the last engines ordered, and the advisability of going further with this arrangement hinges on the saving effected as against the price of the job.

We hope the convention will deem it proper to cause to be investigated: The efficiency lost from radiation; the most effective and economical method of lagging; the efficiency loss from initial low pressure; smaller steam line and governors than recommended, and the efficiency loss from exhausting against back pressure.

A Convenient pipe bender

A CONSIDERABLE amount of pipe bending is required in connection with repairing air brake equipment on passenger and freight cars. This work can be made much easier and speeded up by the judicious location of pipe bending machines such as shown in the illustration. It consists of a 12-in. air brake cylinder and a substantial



An inexpensive pipe bending machine

work table, both bolted to one of the building columns. The forming dies used on the end of the cylinder piston rod are made from iron or steel, while the dies used on the table are made of wood reinforced on the sides with metal plates. The fact that the cost of making these dies is small, permits the machine to be equipped to bend most any curve in a pipe of any size common to railway cars.

Construction and maintenance of cars*

Proper design, stability of employment and location of shops and facilities important factors

By L. L. Yates

General superintendent car department, Pacific Fruit Express Company

THE advance made in the last quarter century, in railway equipment and its attendant construction and maintenance facilities is immensely greater than in all preceding time. Volumes could be written on the subject of car construction and maintenance, each requiring a specialist in some particular line. The subject is so broad, involving such a diversity of experience, knowledge and training in each of its branches, that no one man is qualified to do it justice except in a general way and therefore we must confine ourselves to a few outstanding high lights common to all branches, leaving the detail to be filled in by the individual imagination.

Primarily the railroads are in the business of transporting freight and passengers, a service which they render the public for remuneration and profit. The profit is small compared with the extremely large volume of business. It is plainly seen then that there must be a well balanced ratio between earnings, investment and maintenance to produce the profit to which the roads are entitled.

Investment does not fluctuate and can justly be considered as the center of the balance while earnings and maintenance at either end of the beam must be carefully watched.

Importance of proper car design and maintenance

Properly constructed and maintained equipment has a direct bearing on economical investment and maintenance costs and railroad service can not be sold profitably except as such is the case.

Car movement, organization of shop personnel, location and arrangement of shops and yards and efficient, adequate shop machinery and tools are the four most important factors in the construction and maintenance of railway equipment.

To construct a thing cheaply it must be made in large quantities; likewise minimum repair costs are contingent upon quantity. Car movement, then, is the center about which the whole program revolves and an element beyond control of any shop or maintenance force. The movement of cars is most active when business, industry and agricultural enterprises are prosperous. During such periods we find extensive programs for the construction of new equipment and repair facilities, but generally speaking maintenance work is at a standstill because equipment can not produce revenue on a repair track. On the other hand when there is a general depression and conditions are not so prosperous there is a large quantity of idle equipment which, if it were economically possible to transport to repair points, its maintenance could be carried on in the most efficient manner. Under such an ideal condition shop forces could be organized to best advantage, repair work properly classified and parts produced in the most economical quantity.

Organization of shop forces and personnel is the second important factor which is too often overlooked, not alone by railroads, but by others as well. Steady permanent employment produces an ideal condition never to be hoped for while there is such a wide fluctuation in car movement through repair points.

The selection of efficient workmen and leaders is no small task; for example, during the world war 1,700,000 men representing a fair sample of the population of the United States were examined as to their mental efficiency. Of these, ten per cent were so low in the mental scale that they were unfit for soldiers. The demands of a railroad upon the individual are quite as severe as those of the army.

When railroad employment is steady and permanent, the workman finds himself surrounded by a favorable environment, and under constant and careful supervision and training more efficient results can be attained. Often such conditions are overlooked by the employee and in times of business activity he has a disposition to move about, due to restlessness under the necessary discipline of organization and he is often tempted in a baseless hope of betterment.

Labor turnover is not altogether a responsibility of the railroad. It is one of the phenomena of prosperous times.

Proper location of repair points and arrangement of facilities

The proper location of repair points and the arrangement of yards, buildings and machinery is such an elementary phase of the subject that a layman is qualified intelligently to enter the discussion from a standpoint of the ideal. However, most of us who have been connected with railroad service for a lifetime cannot point, except in rare cases, to an ideal shop arrangement or location. Traffic, available property, and land values are to be considered in the selection of a shop location.

Repair points of any consequence must necessarily be located near some large terminal towards which the largest number of cars move under load. Such locations permit empty cars to pass directly through the shop for thorough inspection and repair before distribution for reloading. Shops located along the seaboard render it possible to maintain a constant supply of cars through the repair shop with materials at a minimum cost. It is obvious then that property so located is high in value, the shop location where available space permits is not always best adapted to the purpose. Under such circumstances cramped conditions result, reflecting high repair costs all the way through the shop operation, a condition over which there is almost no control.

* Abstract of paper presented recently before the Pacific Railway Club, at San Francisco, Cal.

There is considerable which could be said about the proper arrangement of shop buildings and stores of repair material. Also ample trackage laid out in such a manner as to facilitate the classification of cars under repair, permitting the utmost ease in transferring cars from one point to another with the least switching expense and without fear of jamming the yard.

Continuous, progressive movement of raw materials to the manufactured car part, passing through the shop in one direction is of importance in keeping down the shop costs. When shop buildings and material stores are advantageously arranged, material handling expense is at its minimum. Handling and storage of materials is one of the largest of shop expenses when you stop to consider that one and one-half carloads of manufactured parts are handled to make one complete car of the refrigerator car type. Handling costs are the lowest when the materials are handled the least number of times.

What has already been said about the arrangement of buildings and stores is likewise true of the arrangement of machinery within the buildings.

When we speak of adequate shop machinery and tools we should never lose sight of the word economy.

Construction and maintenance of railway equipment and the upkeep of shop facilities calls into play almost every class of mechanical operation.

Machinery and tools are required which are in constant operation day in and day out while others are either engaged for short periods or are provided for the sake of convenience. Shop superintendents, foremen and workmen very often overlook the fact that idle machinery never assists in lowering manufacturing costs.

Many times there is a tendency to manufacture parts which outside manufacturers could supply at less or no greater cost. Assuming that the price is reasonable it would be better policy to purchase such parts from outside concerns who specialize and produce the article under the supervision of trained experts and who have the best machinery adapted to the purpose. Experiments are costly except that it is definitely known that the article can be produced and economy effected.

Another factor in low car construction and maintenance costs is the concentration of workmen performing identical operations. Keeping a workman continuously busy on one operation to which he is thoroughly trained and limiting the area over which he operates is of great importance.

Repair work should be thoroughly done

What has previously been said deals largely with conditions over which the construction and maintenance organization may or may not have control. There are, however, many minor factors in maintaining equipment over which the organization can exercise perfect control. For instance each unit whether it be man, machine or building can perform its work thoroughly enough to keep the equipment on the road and not in the shop. Equipment must be repaired and maintained but the extent of maintenance is directly governed by the quality of work performed.

Carelessly constructed or repaired equipment causes no end of trouble and expense in train operation once it is loaded and on the road. A repair costing but a few cents at the shop can cause several hundred dollars in train delay if failure occurs but a few miles away.

Important points to watch when repairing refrigerator cars

In the construction of the refrigerator car it is eminently necessary that more care be given than in the construction of other freight equipment. It is first necessary to select the best of the materials, particularly in the superstructure, which as you know, is the only part of the car that materially differs from other freight cars.

The lumber must be well seasoned to prevent shrinkage when framed and assembled. The efficiency, quantity and application of the insulation is of the utmost importance, and has caused more thought than any other one feature entering in the construction of the refrigerator car. It will readily be seen, on account of the belt rails, sills and carlines, the difficulty encountered to maintain the continuity of the insulation, which is highly desirable.

Particular care is taken in the application of the insulation to the car, to see that it is not only securely applied, but all parts protected, and vertical dead air spaces frequently blocked to prevent circulation within the walls, which, if not prevented, would assist in the absorption or radiation of heat.

The insulation in the floor of the car, which by the way is highly important, is more susceptible to damage or deterioration due to the misuse of equipment, such as driving nails or spikes into the floor to brace load, loading ice or commodities requiring ice in packages, and other commodities which later require the washing of floors, with the result that moisture will penetrate the insulation, affecting not only its efficiency as an insulator, but also the floor timbers, causing rapid decay or deterioration.

The floor insulation itself should be as near waterproof as practicable, without impairing its efficiency as an insulator, and when applied should be well coated with an odorless waterproofing compound, with a melting point of not less than 175 deg. F. and must be pliable at zero—highly adhesive when hot and not sticky when cold. This requirement is necessary to meet the extremes of temperature to which these cars are subjected. This waterproofing compound should be liberally used around side walls at the floor line to prevent capillary attraction in the side wall insulation.

Side and end sills should be thoroughly coated after framing, with red lead and oil, or some other preservative of equal merit.

It is also necessary to minimize, if not entirely eliminate the use of bolts through the insulation, as they afford direct channels for the transmission of external temperatures.

The main floor should be of select vertical grain lumber, with edges laid in white lead and oil and coated with raw linseed oil. Other parts of the interior of the car, should receive one coat of raw linseed oil and two coats of waterproof varnish. The floor, side and end lining around ice bunkers should receive a coat of mineral paint carrying high percentage of raw linseed oil to prevent decay from condensation.

There are approximately 140,000 refrigerator cars in the United States, the majority of which have been constructed in recent years, and are built in accordance with recognized designs, suitable for the business for which they are intended. There are, however, many older cars that are receiving general repairs to make them conform to modern methods of construction.

Methods of repairing refrigerator cars

The Pacific Fruit Express Company owns and operates in excess of 33,000 refrigerator cars of the most modern type, and to maintain them in a high state of efficiency, each car as it returns to California after a trip east, before being placed for loading, as a rule passes through one of our shops, whether or not it is

in need of repairs, where it receives the most careful inspection by specially trained men, and any defects discovered are plainly marked with chalk and written up on inspection card which is placed on the car door. Following these inspectors, are repair men, who are trained and skilled in their respective crafts making any repairs necessary. Car cleaners thoroughly clean the ice bunkers and the body of the car, and if the car contains oil spots or other foreign matter requiring washing, this work is done by another class of workmen. Interior walls and the ceiling, if in need of revarnishing, are attended to by painters.

After all this work has been performed, inspectors make an after inspection to see that the repairs have been properly made and that the car is in safe and serviceable condition, particular care being given to the side doors to see that they are perfectly tight. The side doors are then closed and sealed with a heavy wire, and the ventilators set in an open position, permitting thorough ventilation.

This work is all performed in what we classify as the light repair yard. Any cars requiring extensive repairs are switched to the heavy repair yard, or reconstruction shed where we employ men specially skilled in the art of rebuilding refrigerator cars, where any of the wood parts or insulation showing decay is removed and replaced with new material, special care being given to the renewing of insulation in a workmanlike manner to see that the vulnerable points are protected. This work is under the supervision of foremen who have had years of experience in refrigerator car maintenance, and who are cognizant of the functions of the refrigerator car, which are considerably different from other types of cars.

No doubt you are all familiar with the location and volume of perishables shipped from Pacific Coast points, which include California, Oregon, Washington, Idaho and Arizona and the West Coast of Mexico, rendering it impossible at all times to pass cars through our main shops, in which event we have inspectors and repair men at the principal loading centers to clean thoroughly and make minor repairs and on cars requiring heavy or general repairs, they are forwarded to one of our main shops.

In view of the fact that thousands of carloads of perishables are hauled annually from Pacific Coast points in Pacific Fruit Express equipment, it necessarily follows that each of its 33,000 cars receives inspection and repairs an average of seven times a year which aids considerably in reducing car failures.

The construction and maintenance of railway equipment, like most other things of this day and age, does not escape the study of the technical mind. Members and various parts are theoretically designed to withstand certain forces. These members must be connected to one another. Rivets are the usual connecting medium. The designer is staking his whole computation on careful riveting and it is obvious what occurs when defective rivets are driven merely with the intention of plugging a hole. What applies to rivets equally applies to welding and blacksmith work.

Consideration must also be given to cleanliness and the proper care of scrap and usable materials not particularly from the standpoint of general shop appearance, but because workmen can perform their work more efficiently when an orderly condition prevails in the shop.

In conclusion let us bear this thought in mind; that it is our first and foremost duty to keep the equipment on the road, in which event the other troubles will care for themselves.

Cause and prevention of hot boxes*

By A. G. Hill

Foreman, car department, F. W. & D. C., Ft. Worth, Texas

JOURNAL boxes run hot from various causes. The principal defects are inferior material used in journals, journal brass and journal brass lining; worn and untrue wedges; untrue seats in the journal boxes; missing and worn dust guards; inferior packing; lack of proper lubrication; hard spots in journal brass lining; untrue journals; worn fillets and worn collars, and cracked lining or a broken brass. A broken brass is usually caused by the brass being too narrow or too small for the journal, causing it to spread and break in the center, resulting in a hot box. All brasses should be checked before they are lined to see that they are the proper size. Linings should be of the proper thickness and checked again to see that they are of the proper dimensions. Lining should be free of all blow holes and should be tight in the brass, as a loose lining in running warm on a bearing will often turn out of the brass, causing a hot box. Blow holes often have small shavings in them, or a cinder, or a grain of sand will get in the hole and cause friction which results in a hot box and often a cut journal, resulting in the expense of changing the wheels, as well as delaying the car and lading. It also causes unnecessary switching and usually a disatisfied patron. The relining of journal brass in the ordinary railroad shop is false economy. One reason for this is that it is generally thought that most any coppersmith helper or apprentice can do the job. The lining is usually melted from the old brass which has more or less scrap metal, sand and cinders in it and is not properly skimmed. This sediment in the lining causes hot boxes, as the lining is not properly poured in the brass. Burned babbitt and babbitt not properly mixed leaves hard and brittle spots, this also causes hot boxes.

Inspection of journals and brasses should be given close supervision before applying, to see that the journal is in perfect condition and free from all pits, scales and cuts; that the journal does not have high and low spots or any hard or crystalized spots, and that the brass has a perfect fit on the journal. The inspector should also see that no dirt, grit or waste is left on the journal before the brass is applied and that the wedge is in place and fits the brass and box. After doing this, pack the box in the following manner: Take new, or properly renovated packing, make a plug and insert it in the back of the box. The ends of the plug should be well pointed. Tamp tightly, so the plug seals up the opening in the box, to prevent dirt or any foreign matter from getting in and also to prevent the oil from running out. Then apply the packing loosely out to the collar and half way up the journal. Make another plug, insert it down in the box with one side of it under the collar extending up to the center of journal, tapering it down at 45 deg. and out to the end of the box. Then apply a little oil to insure prompt lubrication as the journal warms up.

This is the time to fight the hot box and if the above plan is carried out in applying wheels, you will have no hot boxes off your repair tracks.

Proper inspection of journals and brasses as well as packing is made in the following manner: First, examine the wheel and if oil has been running out on the wheel, this is a sign that the box has been giving trouble, or is going to. As a general rule the appearance of oil on a wheel indicates that the packing was not shoved back to

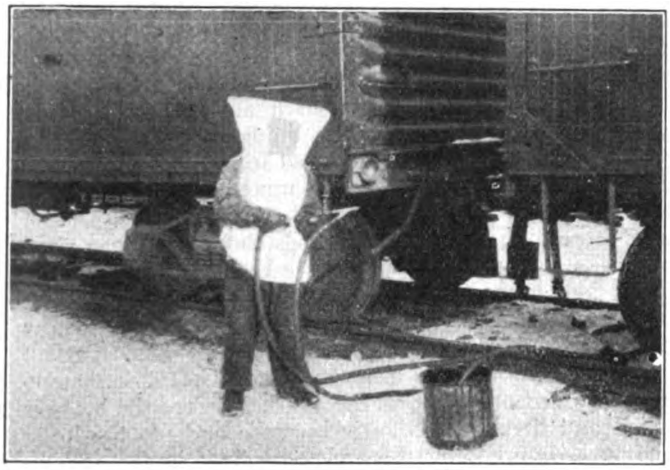
* Abstract of paper read at the April meeting of the Texas Car Foremen's Association, Fort Worth, Texas.

make a close fit around the shoulder of the journal so as to lubricate the journal and seal up the opening of the box. Then open the box lid and if the journal looks black or the packing is dry, examine the journal with a sharp pointed hook. If the journal is rough or cut, the box should be jacked, the brass removed, and the brass and journal given a thorough inspection to locate the trouble. Apply the necessary remedy, which is usually a new brass and packing and in many cases, shopping for a new pair of wheels.

There are other causes for journal boxes running hot, such as rough handling in switching, knocking brasses and wedges out of place and the brass jumping up so that waste grabs get under the brass. Any of these will cause a box to run hot very quickly. Sometimes trainmen derail cars out on the road and the brasses are turned over or otherwise thrown out of place. This causes hot boxes. Many times the train crews do not report a derailment in order to avoid explaining how it occurred.

Protector for paint sprayers

THE growing use of paint spraying machines has confronted the railroads with the problem of adequately protecting the workmen against the fumes and mist of paint thrown off during the operation. To protect the workmen against this undesirable menace, many types of masks have been devised. The chief objection to many of them has been that they are too



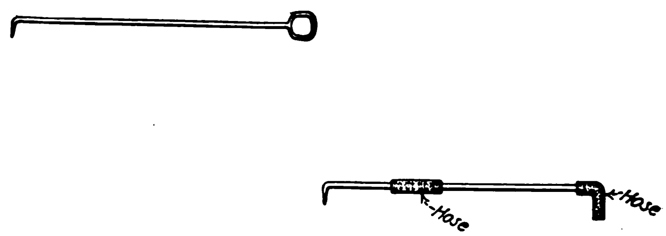
Painter fully protected for paint spraying

heavy and bulky for complete comfort to the painter. The protector shown in the accompanying illustration is not only light in weight but serves the dual purpose of guarding the painter against the paint mist and of protecting his clothes. It is made of heavy canvas, stitched up the sides, with an air opening at each side at the top. The operator looks through a 6-in. by 8-in. glass set in a metal frame. This protector is simple to make, at a minimum cost.

Improved hook for removing journal packing

By Jos. C. Coyle

AN oiler at the Denver & Rio Grande Western car shops, whose job it was to remove the packing from the journal boxes of cars being rebuilt, found that the packing hook used tended to paralyze his right hand, by cutting off the circulation. This was because the ring shaped handle of the packing hook had evidently been made without a thought of comfort or efficiency. A few moments at the blacksmith shop, together with the use of a sharp pocket knife and a discarded piece of hose, soon changed the tool into a handy one, with a comfortable piston grip. It was found that the improvement greatly



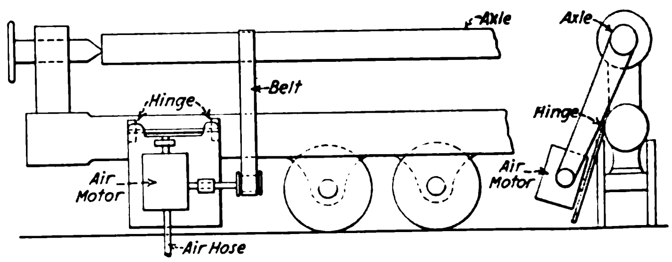
The old style packing hook is shown at the left, the improved hook at the right

facilitated the work and protected the workman's hands from harm.

After reshaping the handle of the hook, which was made of a 3/8-in. steel rod, an air hose was cut to a suitable length and simply slipped over the handle, the crook holding it firmly in place. A second section of hose was slipped on the rod from the point which made a sliding grip for the other hand.

Device for revolving axles on a straightener

SHOWN in the sketch is a device for revolving axles on a Watson-Stillman axle straightener which is being used in the wheel shop of the Lehigh Valley at Sayre, Pa. The use of this device has eliminated the services of an extra man for this job, all of the work of axle straightening now being performed by one man. Referring to the sketch, an air motor equipped with a flange belt motor is secured to the carriage of the axle straightener by means of two hinges. A belt is passed



Sketch showing the application of an air motor for revolving car axles on an axle straightener

around the axle and pulley of the air motor, the weight of the motor keeping it taut. The axle to be straightened is placed between the centers as shown. As the air motor revolves the axle on the centers, the operator takes a piece of chalk and marks the part of the axle which turns out of line as it revolves. The chalk marks enable the operator to tell at just what points the axle needs to be straightened and it can be used as a guide when the axle is placed between the dies of the machine. This operation can be repeated at any time during the straightening process so that it tends to provide greater accuracy in straightening axles.

Progressive car repairs at Little Rock

Material delivered to fixed stations and cars moved from station to station—Marked reduction in cost effected

IN the freight car department of the Missouri Pacific shops at Little Rock, Ark., the progressive system of freight car repairs has been adopted with excellent results in the reduction of rebuilding costs. In connection with the progressive system, a scheduling and routing plan similar to that employed in the locomotive department of the same shops has also been adopted in this shop.

In the rebuilding of freight cars under the progressive system, the material is delivered in advance, the cars to be repaired being stripped in the yard. Such parts as are reclaimable are reclaimed and delivered to their respective positions on the repair line. The trucks are rebuilt on an inbound truck track. The endeavor is to keep trucks for 25 cars constantly in advance of the car men.

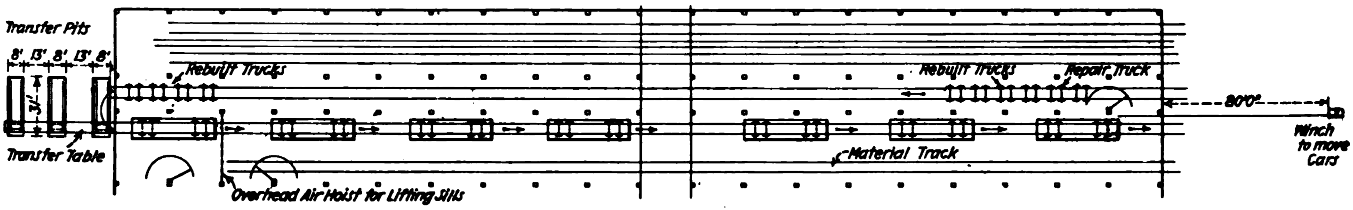
As the trucks are completed, they are moved across a transfer table so constructed as to carry either single trucks or a complete car body from which it has been found unnecessary to remove the steel center sill.

These cars then start on their movement down the erection track, and progress in specified moves from position to position, with the material for each operation stored immediately adjacent to the position concerned. In repairing flat cars, the operations on which are here described, a move is made every 45 min., and 10 cars a day are turned out. The work performed at each station is as follows:

First operation, Stripping and dismantling cars,
12 Laborers.

Second operation, Rebuild trucks,
2 Truckmen
3 Helpers

Third operation, Apply draft arms to center sills, stake pockets to side sills, assemble center sills to truck bolsters.
4 Carmen
2 Apprentices

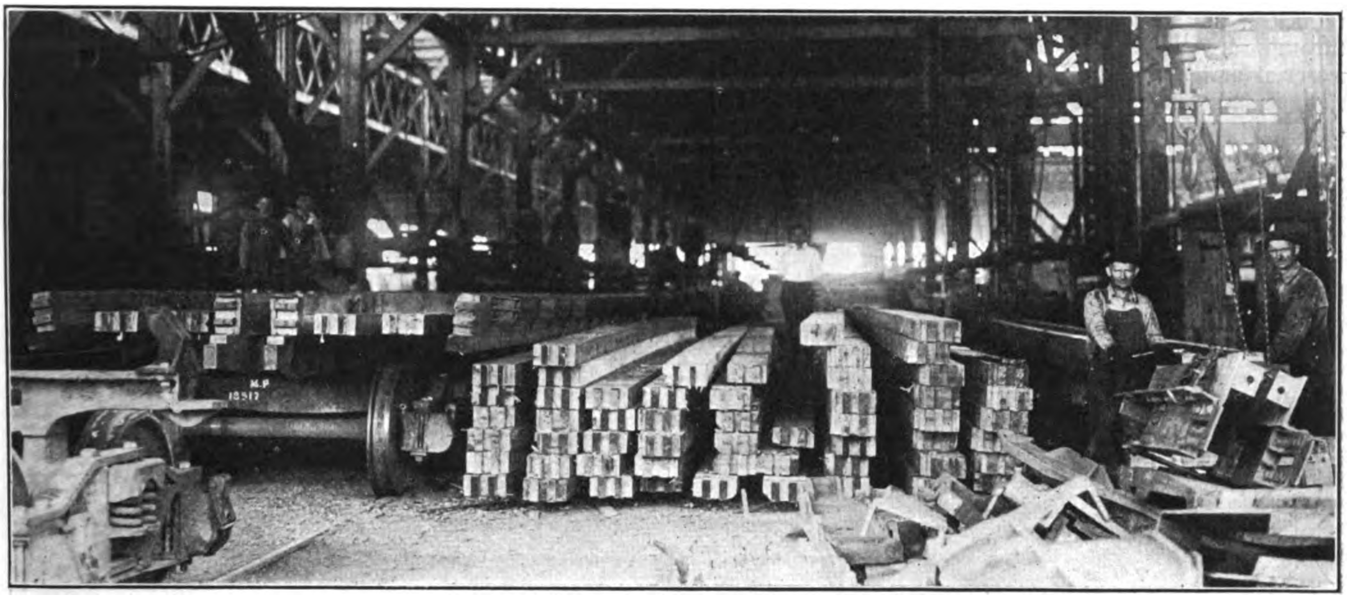


Progressive method of handling and rebuilding freight cars at Little Rock, Ark., on the Missouri Pacific

Fourth operation, Bolt down side and center sills, apply sub-sills, crossties and cylinder blocks,
5 Carmen
2 Apprentices

Fifth operation, Apply end sills and truss rods,
4 Carmen
1 Apprentice

Sixth operation, Apply couplers and outside brake beams,
2 Truckmen
2 Helpers



Second operation—Assembling sills, draft arms and stake pockets

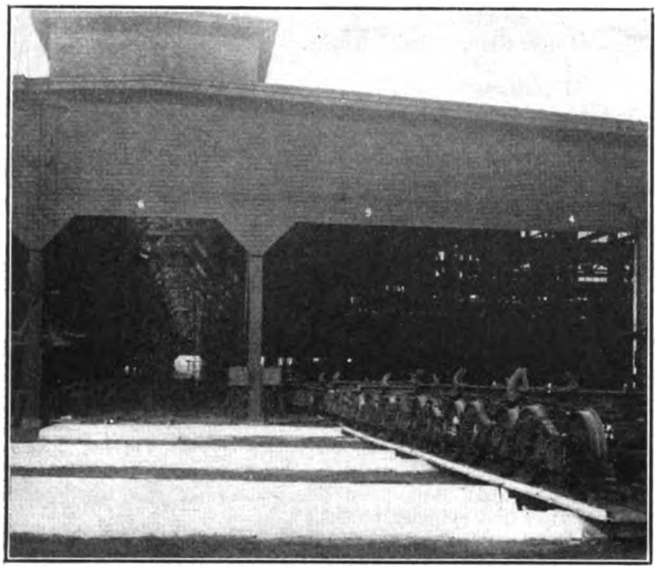
Seventh operation, Apply safety appliances and air brake,
3 Carmen
2 Apprentices

Eighth operation, Lay and spike decking,
2 Carmen
1 Helper

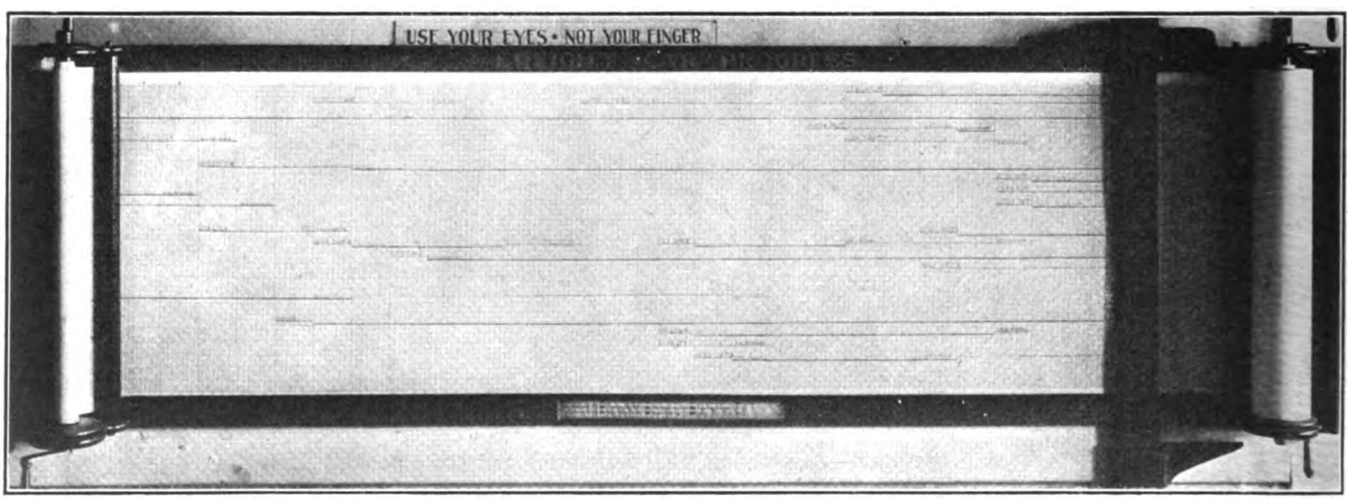
Ninth operation, Paint and stencil,
1 Painter
1 Helper

The total man-hours consumed per day per car are 38.4. With the present number of men, however, it is felt that three laborers can be removed from the stripping gang, and with the receipt of the Dayton spike driver for nailing decks, one man can be removed from this operation.

The handling of material from the wood mill to the freight car shop operates on schedule to insure prompt delivery and eliminate any delays. The old method of building freight cars by delivering the necessary material to each car where it was jacked up on the line was costly. A cost check at this time reveals a 38 per cent reduction in the cost of rebuilding cars, brought about through installation of facilities for promptly handling material and elimination of hand labor wherever possible; such as conveniently located air hoists, air drills and reamers, motor-driven socket wrenches, car pullers, etc.

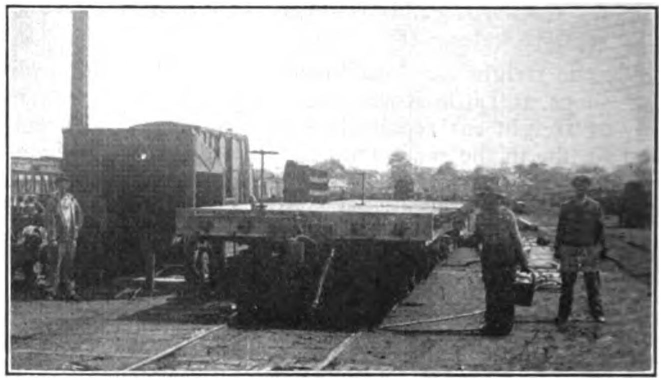


Truck transfer table for moving repair trucks to the erection track



Freight car progress board at the Little Rock, Ark., car shops

One of the features of the scheduling system which is applied to both passenger and freight car repairs at the Little Rock shops is the master progress chart of new design. This chart is so constructed that it operates on rollers carrying a continuous roll of drawing paper 20 in. wide and 50 yards in length. This permits the carrying of a two years' record of performance for reference, visualizing complete data, such as the "in shop" date, the scheduled date out of shop, and the actual date of delivery, together with clear indications of any departments responsible for delays incurred during the shopping period. The progress is indicated by a line, in a single color if the progress is normal, but in a changed color at any time that a delay is experienced in the scheduled progress of the work. This color indicates the departments responsible for the delay. A more complete description of the scheduling system, as it is applied in the Little Rock locomotive shops, will appear in a later issue.



The tenth or final operation of stencilling

Cost of fuel in 1925.—The average cost of coal to the railroads in 1925 was $2.72 per net ton, as compared with $3.03 in 1924, according to the Interstate Commerce Commission's monthly statement of the cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I roads, not including switching and terminal companies. The cost ranged from $1.78 in the Pocahontas region to $4.66 in the New England region. In December the average cost of coal was $2.63, as compared with $2.83 in December, 1924. The roads consumed 97,477,842 net tons in 1925, as compared with 97,917,613 in 1924, and the total cost of coal was $264,747,386, as compared with $296,790,900 in 1924. The average cost of fuel oil for the year was 3.13 cents per gallon, as compared with 2.78 cents in 1924, and the roads used 65,277,735 gallons, as compared with 58,355,823 in 1924. The total cost of coal and fuel oil for the year was $330,025,121, as compared with $355,146,723 in 1924.

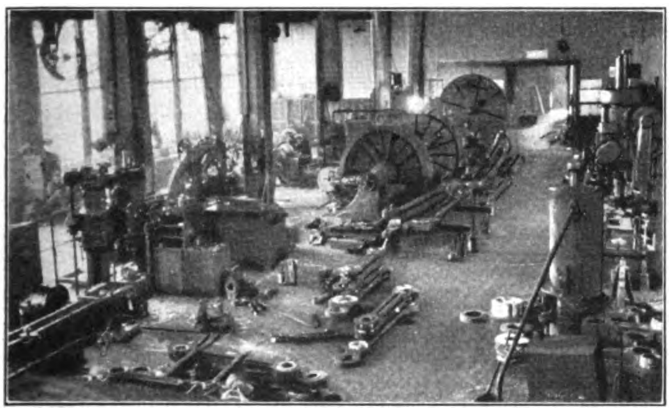
Pennsylvania East Altoona engine terminal

Over 200 freight locomotives turned daily—Method of handling work on sidings and in house

Part II

A WATER pumping station and three large storage tanks are located along the west section of the enginehouse. The largest tank has a capacity of 183,000 gal., while the two smaller tanks each have a capacity of 35,000 gal., which gives a total water storage of 253,000 gal.

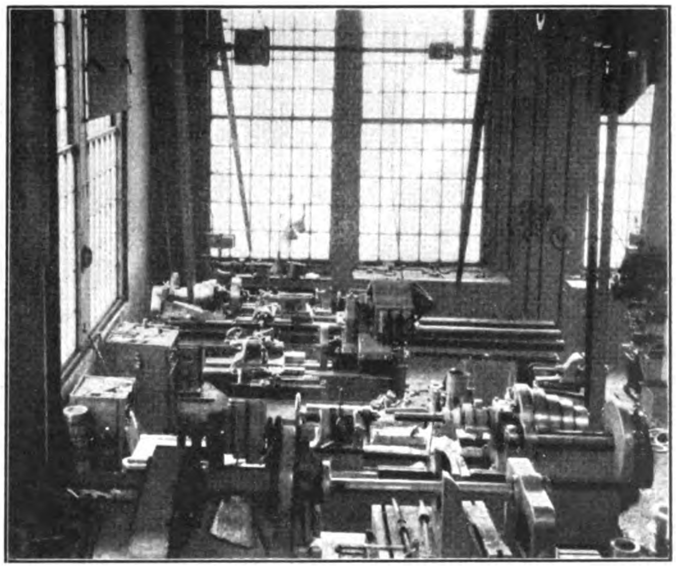
The power plant located at this point supplies the enginehouse layout with hot and cold water, steam, air, electricity and hydraulic pressure, as well as air to the classification yards.



A general view of the machine shop looking towards the blacksmith shop

Storage sidings

The storage sidings are located just east of the enginehouse, one on each side of the layout. The siding on the northern side is for west bound power which has a storage capacity for 75 locomotives and that on the south side is for east bound power which has a storage capacity for 60 locomotives. Each storage siding has two work pits approximately 200 ft. long, where underneath repairs are made. Each siding is provided with an emergency service building containing necessary tool equipment, oil supply and working material stock bins. A main service building is located at the west bound siding. This contains an office for the supervision and clerks and a complete set of piecework charts for use in connection with the work originating on the storage sidings.

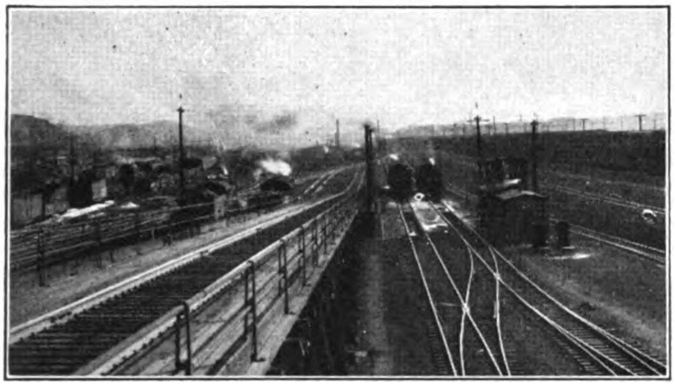


A corner of the machine shop, showing a group of the engine lathes

An emergency hospital car is located just west of the

service building on the east bound siding. This car is fully equipped with 20 hospital cots, a stove, sterilizer, surgical instruments and medical supplies. All accidents occurring anywhere in the enginehouse layout are first treated in this car. One of the clerks working in the main office has received instructions from the local hospital as to the proper way to give first aid to all classes of injuries.

A 110-ft., three-point suspension turntable is located at the extreme eastern end of the engine terminal. This

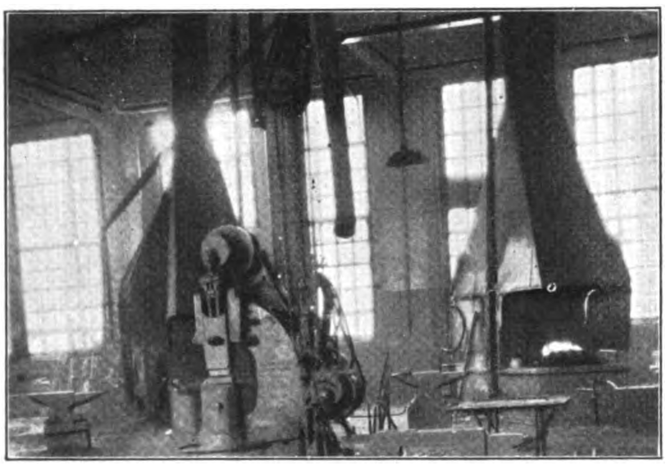


The inspection pits looking toward AL tower at the western end of the layout

table is used to turn the power before it is placed on either of the two storage sidings.

Organization of employees

The figures for the month of December, 1925, show that a total working force of 1,134 men were employed at the East Altoona terminal. Table II shows the distribution of the working force according to tricks and crafts. During the first trick, 566 men were employed of whom 229 worked in the enginehouse and 283 on the outside; during the second trick, 311 men were employed,



The blacksmith shop

142 of whom were in the enginehouse and 159 on the outside; during the third trick, 257 men were employed, of whom 81 were in the enginehouse and 163 on the outside.

There were ten gangs in the enginehouse during the first trick; seven of these were machinist gangs, two were boilermaker gangs, one was made up of carpenters and tender repairmen and one was the boilerwash gang; during the second trick there were five gangs, four of which were machinist gangs and one a boilermaker gang; during the third trick there were two gangs made up of machinists, boilermakers, pipe fitters, etc. During the first trick one of the machinist gangs is known as the miscellaneous gang, which repairs feedwater heaters, stokers, gage cocks, water columns, piston packing and inspects wedges and the locomotive machinery. These men are all specialists in their work.

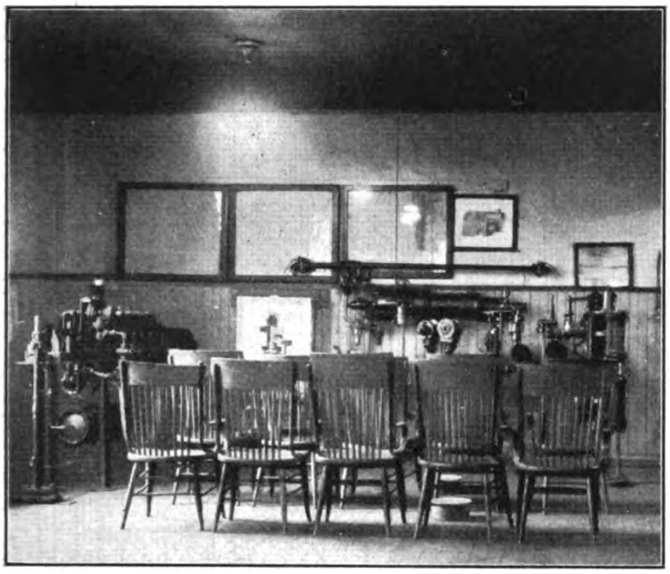
On the outside of the enginehouse there are 12 gangs on the first trick and eight each on the second and third tricks. These gangs are located at the locomotive storage sidings, ash pits and inspection pits.

Space will not permit the analysis of the duties of each gang at this terminal. The duties of the men at the inspection pits are of interest as these men are all specialists. There are 11 inspectors on each trick divided as follows, six outside and three underneath machinery inspectors, and two air brake inspectors. The duties of the outside machine inspectors are to examine all external machinery and the tender; underneath inspectors inspect all machinery of a locomotive accessible only by the use of a pit, gage, test and adjust the water scoops and assist

Table II—Distribution of working force at East Altoona engine terminal by tricks and crafts

	1	2	3	Total
Office				
Lead clerk	1	0	0	1
Clerks	16	5	8	29
Dispatches	2	2	2	6
Gang foremen, special duty	4	1	1	6
Machinist	1	0	0	1
Machinist helper	1	0	0	1
Machinist apprent ce	5	0	0	5
Piece work inspector	1	0	0	1
Messengers	2	0	0	2
Extra hostlers	20	0	0	20
Enginehouse				
Foremen	1	0	1	2
Assistant foremen	1	0	1	2
Gang foremen	10	5	2	17
Machinists	69	48	25	142
Machinist helpers	54	49	25	126
Machinist helper apprentice	4	0	0	4
Machinist apprentice	6	0	0	6
Boilermakers	15	8	3	25
Boilermaker helpers	22	13	3	38
Boilermaker helper appren	1	0	0	1
Boiler washers	2	1	1	4
Boiler inspectors	2	1	1	4
Locomotive inspectors	1	2	1	4
Pipe fitters	6	2	2	10
Pipe fitter helpers	3	2	2	7
Tender repairmen	9	3	3	15
Tender repairmen helpers	5	4	2	11
Carpenters	2	0	0	2
Painters	1	0	0	1
Oilers	2	0	0	2
Locomotive preparers	4	4	4	12
Laborers	8	1	0	9
Clerks	2	0	0	2
Yard gangs				
Assistant foremen	1	0	1	2
Gang foremen	5	5	5	15
Gang leader, ashmen	1	1	1	3
Gang leaders, laborers	3	1	0	4
Machinists	54	29	24	107
Machinist helpers	26	23	23	72
Machinist helper apprentices	2	0	0	2
Machinist apprentices	4	0	0	4
Boilermakers	2	0	3	5
Boilermaker helpers	2	0	0	2
Locomotive inspectors	12	12	12	36
Electricians	5	2	3	10
Electrician helper apprentices	1	0	0	1
Electrician helpers	2	0	0	2
Plumbers	1	0	0	1
Pipe fitters	5	0	0	5
Pipe fitter apprentice helpers	4	0	0	4
Crane operators	2	1	1	4
Turntable operators	2	2	2	6
Stationary engineers	1	1	1	3
Stationary firemen	4	4	4	12
Blacksmiths	3	1	1	5
Blacksmith helpers	5	1	1	7
Coppersmiths	1	1	1	3
Coppersmith helpers	1	0	0	1
Sheet metal workers	1	0	0	1
Toolroom attendants	1	1	1	3
Laborers	77	27	27	131
Hostlers	24	23	21	68
Locomotive preparers	12	11	11	34
Switch attendants	2	2	2	6
Oilers	7	7	7	21
Clerks	2	2	1	5
Truck drivers	2	0	0	2
Janitors	4	2	1	7
Ashmen	2	1	0	3

the air inspector in the cab in testing the brake equipment. The duties of the air inspectors are to test all air equipment, the stoker, the feedwater heater and injectors. They make all light repairs, such as changing feed valves and air compressor governors and adjust the bell ringers and the driving and tender brake cylinder piston travel. One air inspector works in the cab and operates the brakes, stokers and feedwater heater, while the other on the ground inspects the brake rigging, checks the brake piston travel and makes necessary light repairs. One machinist is assigned at the inspection pit to oil and adjust the wedges. Another machinist, who is known as the cab inspector, looks after the certificates, gage cocks, etc. He



The west end of the air brake instruction room, showing the triple valve test rack at the left

also directs the movement of the power to the storage yards and acts as an extra supervisor when needed. The headlights are not examined at the inspection pit as this work is done on the storage sidings. In addition to the workmen already mentioned, there are located at the inspection pit a box packer for grease cellars, a man who sponges the engine trucks, trailer and tender journals, two grease cup fillers, one tool boy who removes surplus supplies and tools from the locomotives, one lamp filler who cleans and fills all lamps and one front end boiler inspector.

It will be noticed in Table II that 20 extra hostlers are listed as part of the office force during the first trick. The names of these hostlers are carried on a crew board. They are called for duty in rotation. The purpose of these extra men is to fill in vacancies caused by absence. They are also called when the regular forces are not able to handle an emergency situation caused by an exceptionally large number of locomotives arriving at the terminal. The extra hostlers average six days a week.

Method of handling locomotives through East Altoona terminal

The locomotives enter the enginehouse layout at AL tower, located at the west end of the terminal. The arrival time of a locomotive is taken at this point. This tower is operated by a switch attendant, under the supervision of the inspection pit foreman. Engines from the west are directed to the two inspection pits south of the coal trestle and those from the east to the pits north of the coal trestle. The locomotives before they are moved onto the inspection pit are washed by two men. Located at the inspection pit are two hostlers, one for each of the two tracks, who move the locomotives onto the pits and take them to the ash pits.

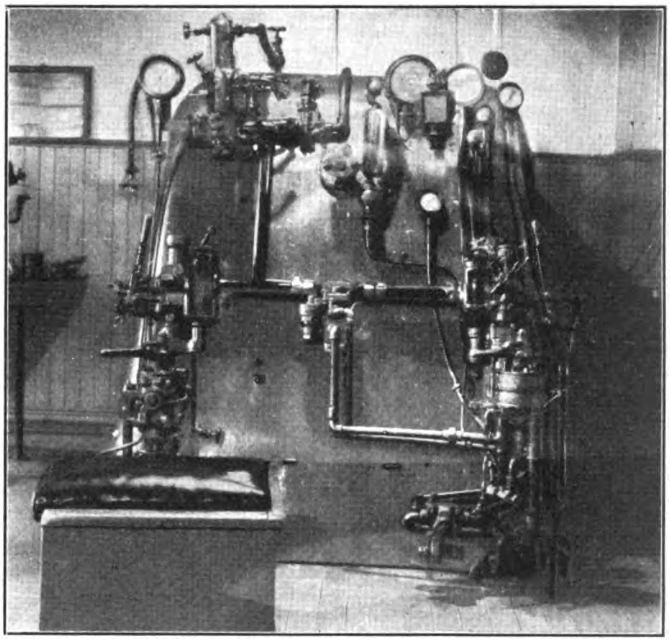
The inspectors make out their work reports after the locomotives are inspected and these are attached to the enginemen's work reports. The reports are then checked and notations made on them of the repairs made by the inspectors. The reports are then sent through a pneumatic tube to the enginehouse foreman's office where the necessary work charts are made out and the whole turned over to the work distributor located at this office. The average time for inspection is 12 min. for each locomotive.

Before a locomotive is moved from the inspection pit, the cab inspector marks the destination of the engine on the back board on the left side in the cab, using the following code:

O.K.S.—Fire up and place on siding
O.K.H.—Fire up and place in house
F.O.S.—Fire cut and place on siding
F.O.H.—Fire cut and place in house

In connection with this code a list of 40 numerals is used, each to designate one of 40 important jobs commonly encountered in the engine terminal. For example, 0 indicates "Firebox leaking"; 1 indicates "Flues leaking"; 9 indicates "Dry pipe work" and 39 indicates "Change water in boiler."

If, for instance, the cab is "F.O.S. 1," this means that the fire should be dropped and the locomotive placed on the siding on account of leaking flues. The foreman at



A replica of a locomotive boiler head fully equipped with different types of air brakes, together with cut sections of accessories commonly found on a boiler head

the inspection pits notifies the work distributor by telephone as to whether the locomotive will be placed in the house or on the siding and the nature of the repairs. The inspection pit hostler then places the locomotive on the ash pit where it is taken in charge by an ash pit hostler. Before returning to the inspection pit for another locomotive, the hostler makes a notation in a record book of the condition of the fire, the amount of water in the boiler and the steam pressure. The purpose of this record is to protect the inspection pit hostler in case of damage to the locomotive caused by low water.

The ash pit hostler cleans or drops the fire, according to the code notation in the cab, and moves the locomotive

to the coal trestle, where it is coaled and sanded, after which the tank is filled with water by the hostler. He then moves the engine to the 110-ft. turntable located at the extreme eastern end of the terminal, where the locomotive is turned and placed either on the west or east bound siding, as the case may be. The average time of the locomotive from AL tower to its arrival on the storage siding is 1 hr. 55 min.

The work done on the storage sidings

During the first trick, the organization of the west bound and east bound sidings consist of two machinists and one hostler gang and one machinist and one hostler gang, respectively. The second and third trick organization is the same, except that the west bound siding has only one machinist gang. Each siding is provided with a pit for underneath work. The class of work done on the locomotives in the storage siding is as follows: Setting valves, closing and renewing rod brasses, renewing main rod bushings, driving springs, brake rigging, piston packing and other miscellaneous work. In addition, the throttle, stoker, feedwater heater, boiler checks, grates, arch tubes, arches, or any other work requiring the fire to be removed and the locomotive blown down. The locomotives are repaired by two boilermakers and helpers and one machinist stationed at two tracks equipped with steam and water for making repairs and firing up. The tracks are located parallel to the eastern end of the coal trestle. The duties of the hostler leader on the storage sidings are to see that the locomotives are sorted and finally placed on the siding in rotation according to the time each will be available to take care of the coal and water and to check any terminal delays. In other words, after a locomotive has been repaired, the hostler is responsible for its leaving the terminal on time.

Method of handling repairs in the enginehouse

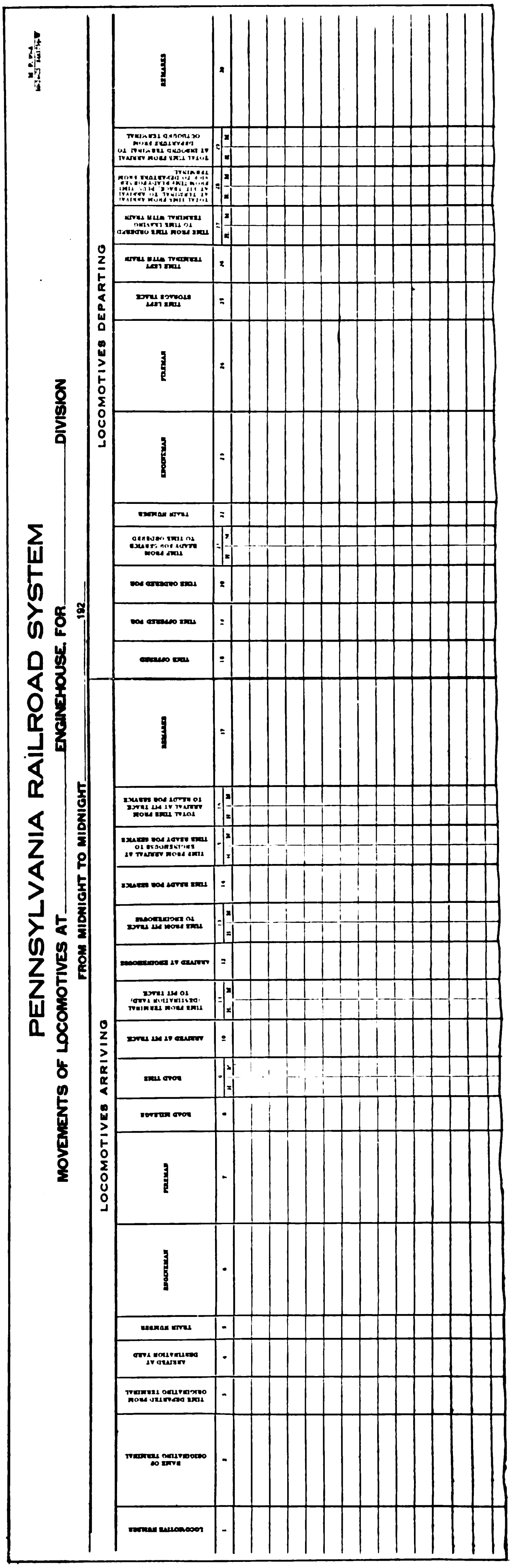
When a locomotive, due for a boiler wash arrives at the inspection pit it is placed in the house by the ash pit hostler. Other work which necessitates a locomotive going into the house includes wheel and driving box repairs, renewal of crown and staybolts, broken frames, removal of superheater units and the renewal of a center deck casting or a cylinder.

The machinery, boiler and tender of a locomotive in for boiler washing is examined by the various inspectors, who are governed in their work by the Pennsylvania Locomotive Maintenance Instructions. The inspectors' reports are sent to the work report clerk in the main office. It should be noted that the valves and cylinder packing are not examined at this time or at any set period, but only when reported on the inspectors' or enginmen's work reports.

The 50 stalls of the enginehouse are divided into three sections, 42 of which are for heavy repairs, four for tank work and four for drop pits. The 42 stalls are divided among four machinist gang foremen on the first trick and two each on the second and third tricks. After all repairs have been made, the locomotives are fired, tested and then passed over to the inspection pit where a thorough inspection is made before they are placed on the storage tracks. Any work found by this inspection is completed on the storage tracks. The ash pit hostlers move the locomotives out of the house.

Method of dispatching power

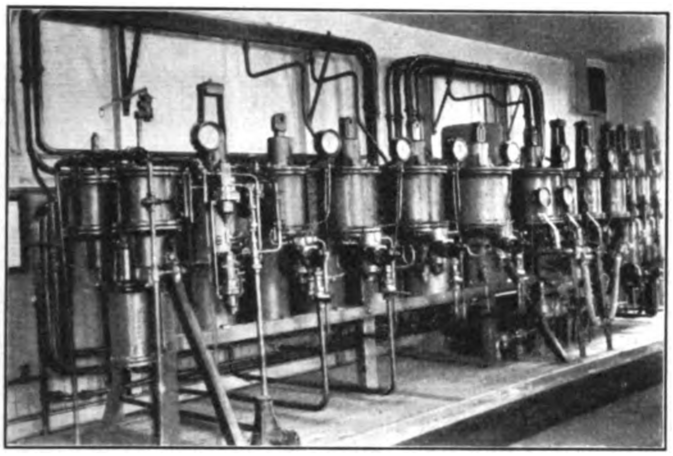
The work distributor keeps the engine dispatchers posted as to the condition of the power and when it will be available for service. The dispatchers usually know about two hours in advance when the locomotives can be ordered. Specific locomotives are not ordered by the



This form shows the movements of the locomotives through the terminal for a 24-hr. period

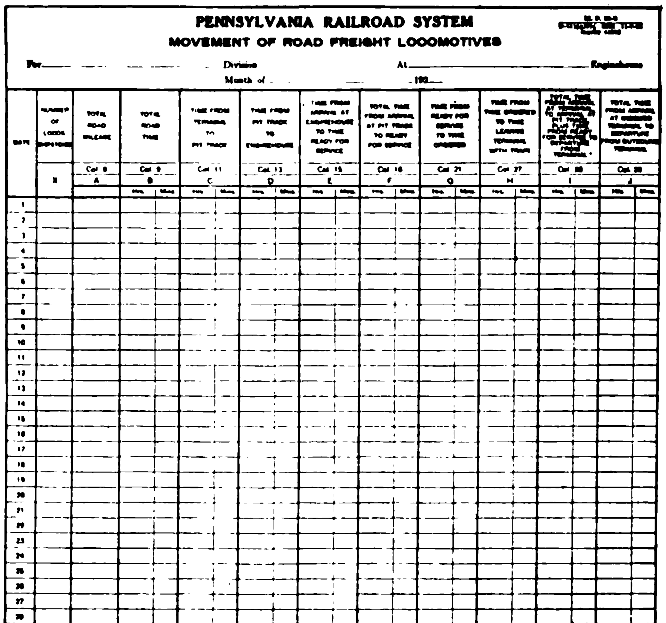
transportation department, but instead this department places an order to haul a certain tonnage train over a designated division. The engine dispatcher selects the locomotive or locomotives suitable to haul the train. In leaving the terminal, the engine crews must pass the storage track foreman's office at the time specified in the call.

A clerk in the engine dispatcher's office fills out what is known as the M.P. 99-A sheet which is a complete record from midnight to midnight of the movements of all locomotives by divisions at the East Altoona enginehouse. This form, which is shown in one of the illustration, is standard on the Pennsylvania System. It is divided into two parts, one a complete record of the locomotives arriving and the other a complete record of the locomotives departing. Columns 1 and 2 are self-explanatory. Column 3 shows the time the locomotive departed from the originating terminal, and column 4, the time of arrival at the destination yard. These columns are filled out from the engineman's time slip. Columns 5, 6 and 7 need no explanation. Column 8 is taken from the engineman's time slip and column 9, or the road time, is the difference between columns 3 and 4. Column 10 shows the arrival at the pit track, which time is taken by the switch attendant at AL tower, where the locomotives enter the jurisdiction of the mechanical department. Column 11, or the time from the destination yard to the pit track, is the difference between columns 4 and 10. Column 12 shows the time at which the locomotive became available for maintenance work, either in the enginehouse or on the storage tracks. It is obtained by the lower turntable operator. Column 13, or the time from the pit track to the enginehouse, is the difference between columns 10 and 12. Column 14, or the time ready for service, indicates the time after which the locomotive may be ordered, and is furnished to the dispatcher by the work distributor. Column 15 indicates the time from the arrival at the enginehouse to the time ready for service and is the difference between columns 12 and 14. Column 16 shows the total time from the arrival to the pit track to the time ready for service, which is the difference between columns 10 and 14, or the total time required by the motive power department to pass the engine through the terminal and have it ready for service. In column 17, remarks may be noted to show any unusual conditions which detain the progress of a locomotive as it passes through the terminal.



This test rack, which is located in the air brake instruction, has a brake pipe volume equal to an 80-car train

Column 18, or the time offered, is the time that the work distributor offers the locomotive for service. The time ordered for service in column 20 is the time designated by the engine dispatcher at which the locomotive must leave the jurisdiction of the engine terminal. Column 21, or the time from ready for service to the time ordered, is the difference between columns 14 and 20. Columns 22, 23 and 24 need no additional explanation. Column 25, or the time the locomotive leaves the storage track, is obtained by the storage track foreman as the locomotive passes his office. If the time in column 25 is later than the time ordered, column 20, an engine terminal delay results which must be accounted for to the general foreman. Column 26 shows the time the engine leaves the terminal with its train. This time is obtained from a tower man in the yard. Column 27 is the difference between columns 20 and 26. The total time from the arrival at the terminal to the arrival at the pit track plus the time from the time ready for service to departure from the terminal is shown in column 28 which is obtained by adding the time shown in column 11 plus the difference between column 14 and column 26. In other words, this column shows the time that the locomotive has been under the jurisdiction of the transportation department from the time of its arrival to its departure Column 29, or the total time from the arrival at the inbound terminal to the departure from the outbound terminal is the addition of the time shown in columns 11,



PENNSYLVANIA RAILROAD SYSTEM

MOVEMENT OF ROAD FREIGHT LOCOMOTIVES

For________ Division At________ Enginehouse

Month of ________ 192__

Date	Number of Locos Dispatched	Total Road Mileage	Total Road Time		Time from Terminal to Pit Track		Time from Pit Track to Enginehouse		Time from Arrival at Enginehouse to Time Ready for Service		Total Time from Arrival at Pit Track to Ready for Service		Time from Ready for Service to Time Ordered		Time from Time Ordered to Time Leaving Terminal with Train		[illegible]		Total Time from Arrival at Inbound Terminal to Departure from Outbound Terminal	
		Col 8	Col 9		Col 11		Col 13		Col 15		Col 16		Col 21		Col 27		Col 28		Col 29	
	X	A	B		C		D		E		F		G		H		I		J	
			Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.	Hrs.	Mins.
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31																				
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Average																				

The average of 11 columns on the M. P. 99-A sheet are transferred every day to this form and at the end of each month the columns are again averaged, which shows the monthly performance at the engine terminal

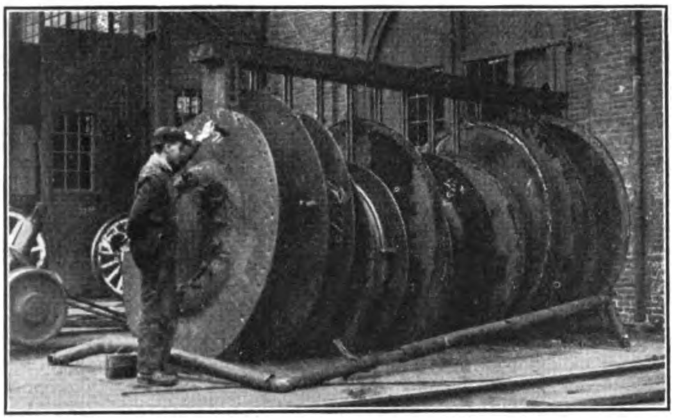
16, 21 and 27. In column 30 any remarks may be inserted which will indicate why a locomotive was late in departing.

At the end of each 24-hr. period, columns 8, 9, 11, 13, 15, 16, 21, 27, 28 and 29 on the M.P. 99-A sheet are added up and divided by the total number of locomotives dispatched. These averages are then transferred to the M.P. 99-B sheet shown in one of the accompanying illustrations. This sheet contains space for a 31-day month and at the end of the month, the figures transferred are again added up and divided by the number of locomotives dispatched to obtain monthly averages for each column.

Rack for storing boiler front ends

By Charles W. Geiger

THE illustration shows a convenient rack for storing the front ends of locomotive boilers. The frame is of timber construction and the partition uprights are made from old boiler tubes. Sufficient space is provided between the boiler tubes for one front end. This type of rack is used in one of the general repair shops of a southwestern railroad and is located just outside of the erecting shop, as shown in the illustration. The use of this rack facilitates the storing of front ends while the locomotive is going through the shop. They can be easily placed or removed without disturbing any of the other front ends as is usually the case when piled against a wall.

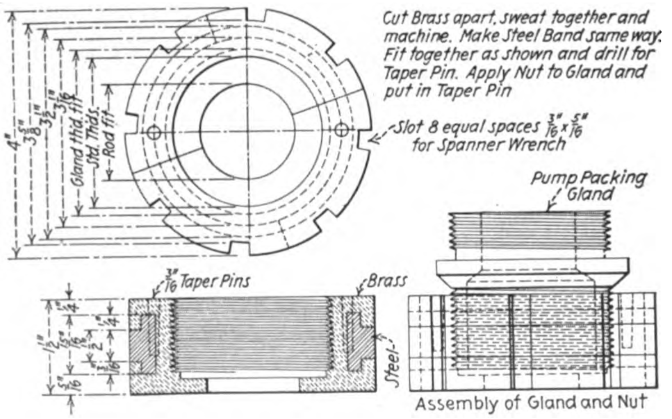


Rack for storing locomotive front ends, made of old boiler tubes

Emergency packing nut for feed-water heater pumps

By W. W. Dooley

THE packing nut, a cross section of which is shown in the sketch, was made for the purpose of reducing the time usually required to renew a burst packing or stuffing box nut, on the piston rod of the water pump of an Elesco feedwater heater or an air compressor. The nut is made in halves which are held together when applied by a steel band, also made in halves which are held in place by two 3/16-in. taper pins. The emergency nut is applied by fitting the halves together on the gland, sliding the halves of the steel band around approximately 90 degrees in the slot and drilling the holes for the taper pins. After the nut is applied to the gland the taper pins are inserted in the holes.



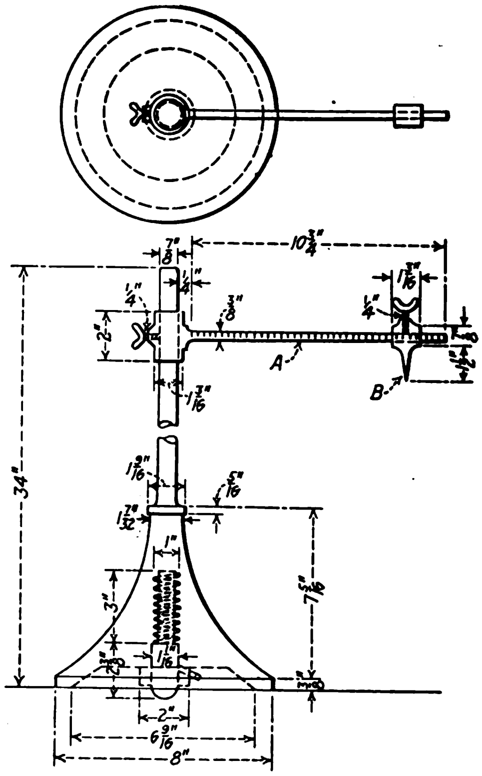
This split stuffing box nut can be applied to the piston rod of a feedwater heater pump or an air compressor in three minutes

This nut was originally devised when we recently had a locomotive ordered for service and a mechanic was sent to pack the feedwater heater pump. He found the packing nut burst and the renewal of this nut caused a four-hour delay. We decided it was cheaper to keep an emergency nut handy such as the one described, for just such occasions. It can be applied on a feed water pump in three minutes.

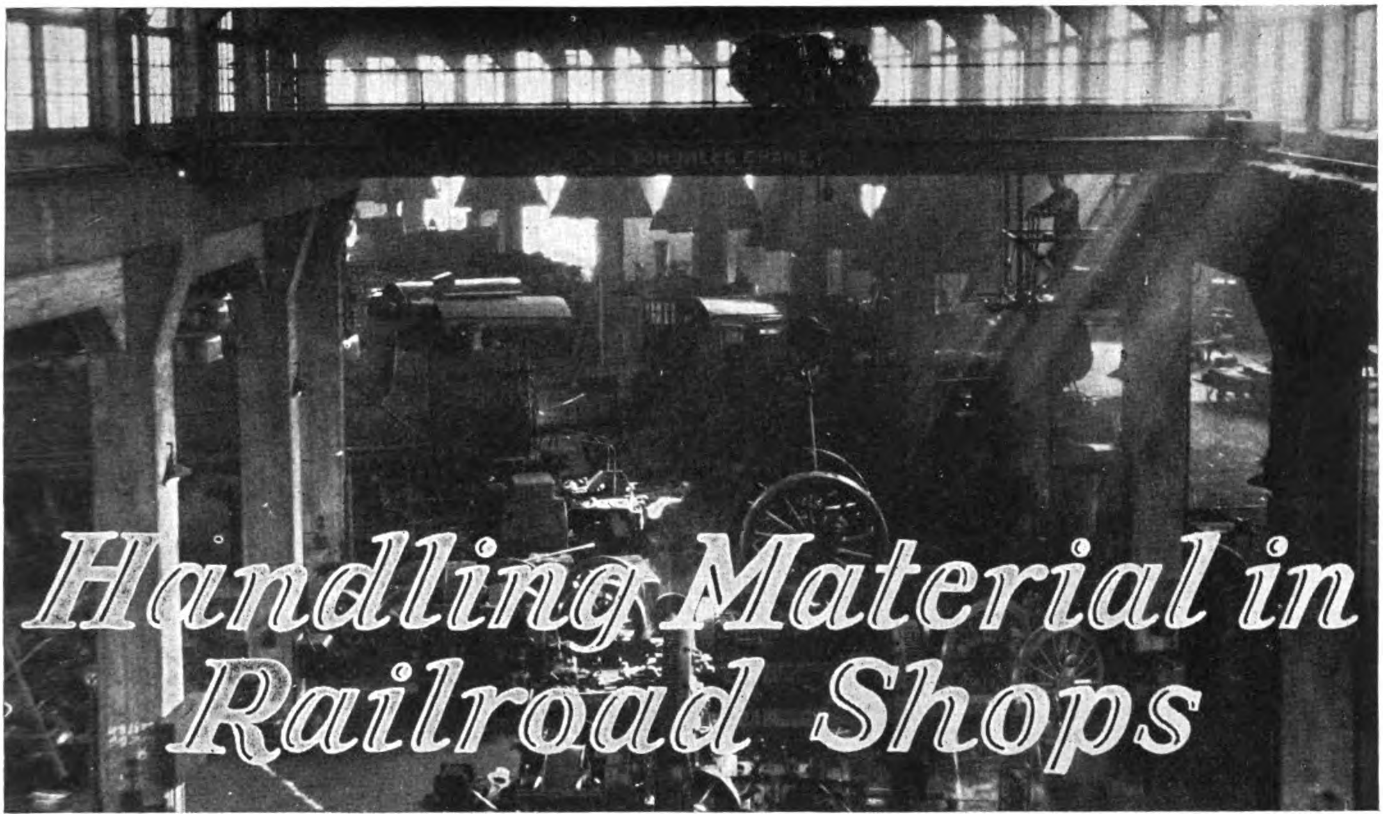
Gage for locating eccentric cranks

By J. Robert Phelps,
Apprentice instructor, A. T. & S. F., San Bernardino, Cal.

ACCURACY is essential when locating eccentric cranks on the main pins. The gage shown in the accompanying illustration has been designed to secure this accuracy. The hollow base of the gage contains a center which is moved in and out by a spring. This center fits into the center of the driving axle. On top of the base is attached a rod 7/8 in. in diameter and 27 in. long, over which slides, at right angles, a graduated rod *A* 3/8 in. in diameter. A movable pointer *B* slides along rod *A*. The point *B* may be set at any distance from the center of the rod without the use of a scale. The rod *A* can be fastened at any position on the perpendicular rod by means of a winged nut.



A graduated eccentric crank gage



Handling Material in Railroad Shops

Developments in equipment have facilitated work of routing material—Efficient operation depends on prompt deliveries

THE methods used in laying out railroad shops have gone through several distinct changes during the past 30 years. It was formerly the practice to build a shop according to conventional ideas and fit in the machine tools and shop equipment wherever they would go. Then came the period of building the shop around the equipment, or to suit the desired layout. We have now entered a third stage in the progress of shop layout methods in which the engineer considers the shop layout largely from the standpoint of handling material from one department to another, as well as routing material through a single department.

There is, however, a fault to be found with the method of laying out a railroad shop with the principal idea of facilitating the handling of material. Quite often an engine terminal with a small machine shop will gradually develop into a large back shop. It is seldom possible to expand in a logical direction and as the shop becomes larger, excrescences will develop at various points in the shop layout that seriously affect the efficiency of any system of handling material.

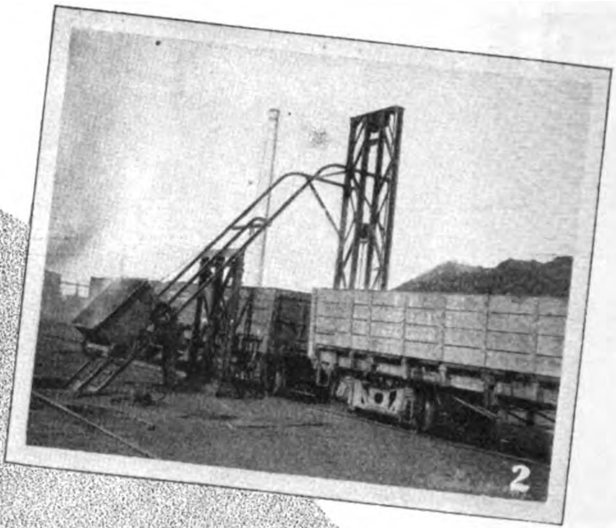
This fault, however, has been a big factor in the development of material handling equipment. Practically all railroad shops have some abnormal or unforeseen development in their layouts that have created difficulties in handling material and, as a result, the managements of the railroad shops have been required to use considerable ingenuity in overcoming these difficulties. In this the manufacturers of material handling equipment have been of invaluable assistance in developing a variety of cranes, conveyors, trucks and other types of handling equipment from among which the mechanical or stores department officer can select that which is best suited to meet his particular problem.

Material handling equipment used in railroad shops may be classified under three general heads, namely, trucks, cranes and conveyors. These classifications may in turn be divided into different groups, according to type of equipment. Trucks include such material handling equipment as the simple forms of hand trucks, carts and wheelbarrows, the various forms of power driven trucks as distinguished from tractors, and tractors and trailers.

Variety of systems used for handling material with trucks, tractors and trailers

The efficient utilization of industrial trucks, tractors and trailers depends to a large extent on the degree of co-operation between the stores and mechanical departments. It has been only during the past few years that many railroads have come to a realization that whole-hearted co-operation between these two departments is essential in order to reduce the cost of locomotive and car maintenance. But during that time rapid progress has been made towards getting the stores and mechanical departments working more closely together.

In many shops all handling of material from the store room or yard to the material station, machine, or car or locomotive, is under the supervision of the stores department. It seems to be the practice, however, for many mechanical departments to supervise the delivery of all material. Requisitions for material are made out by a shop foreman and collected by the delivery man, who delivers them to the stores department delivery attendant for

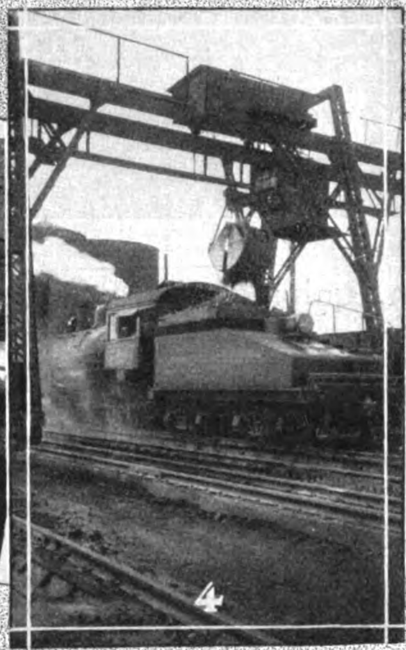
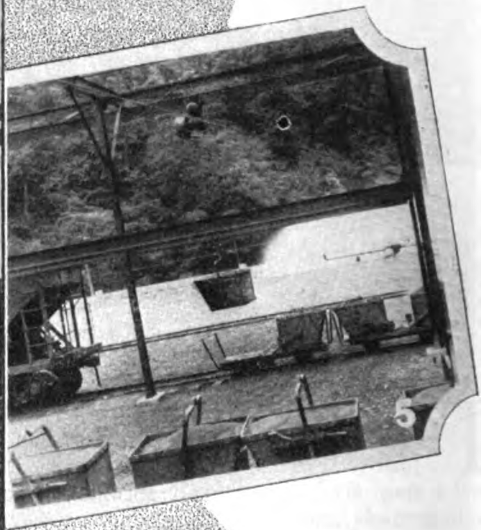



Fig. 1—Locomotive cranes can be used for many kinds of jobs around a railroad shop. Fig. 2—Efficient ash handling equipment facilitates engine terminal operation. Fig. 3—A Whiting 150-ton overhead-traveling crane in a locomotive erecting shop. Fig. 4—Adequate coaling facilities reduce the time of turning locomotives. Fig. 5—Handling ashes from the power plant to the car. Fig. 6—Overhead-traveling crane equipped with a bucket for handling ashes from an ash-pit. Fig. 7—Overhead-traveling cranes can be used to advantage for handling castings in the storage yard

filling. The material is loaded on trailers where it is checked against the requisition and the requisition form is receipted by the man who has charge of delivering the material.

A variety of delivery systems used in various railroad shops throughout the country have been described in past issues of the *Railway Mechanical Engineer*. A typical example of a modern delivery system is that used in the locomotive and car shops of the Lehigh Valley at Sayre, Pa. These shops have organized a system of material delivery that has produced many economies. The equipment used consists of four Elwell-Parker trucks and one Tow-Motor, which are operated by crews of two men each. A variety of trailers for handling different kinds of material, some of which are illustrated, are also provided. These trucks and trailers are operated on a schedule which is rigidly adhered to, emergency requisitions being handled by a special truck. Material stations are located at strategic points throughout the car and locomotive shops at which the truck train stops for the delivery of material and the collection of requisitions or orders for material. The schedule of deliveries and the location of material stations in the locomotive shop is shown in a drawing. A hook is provided at each station on which all orders for material are hung, to be collected by the delivery man.

Perhaps the most modern system both in the kind of equipment and method of operation is to be found in the Scranton locomotive shops of the Delaware, Lackawanna & Western. When the shop was constructed a subway system was built under the plant through which narrow gage tracks were constructed for the operation of cars by electric locomotives. Several years ago the electric locomotive was abandoned as motive power in favor of electric trucks which are now operated through the subways. The rail cars are used primarily for scrap and are moved by electric truck as shown in one of the illustrations.

Material is brought from the stores department by subway to an elevator located at the center of the shop. From this central point all material can be readily routed to any department. Another feature of the operation of this shop is that sub-departments, such as that handling driving boxes, each has a truck assigned to it which

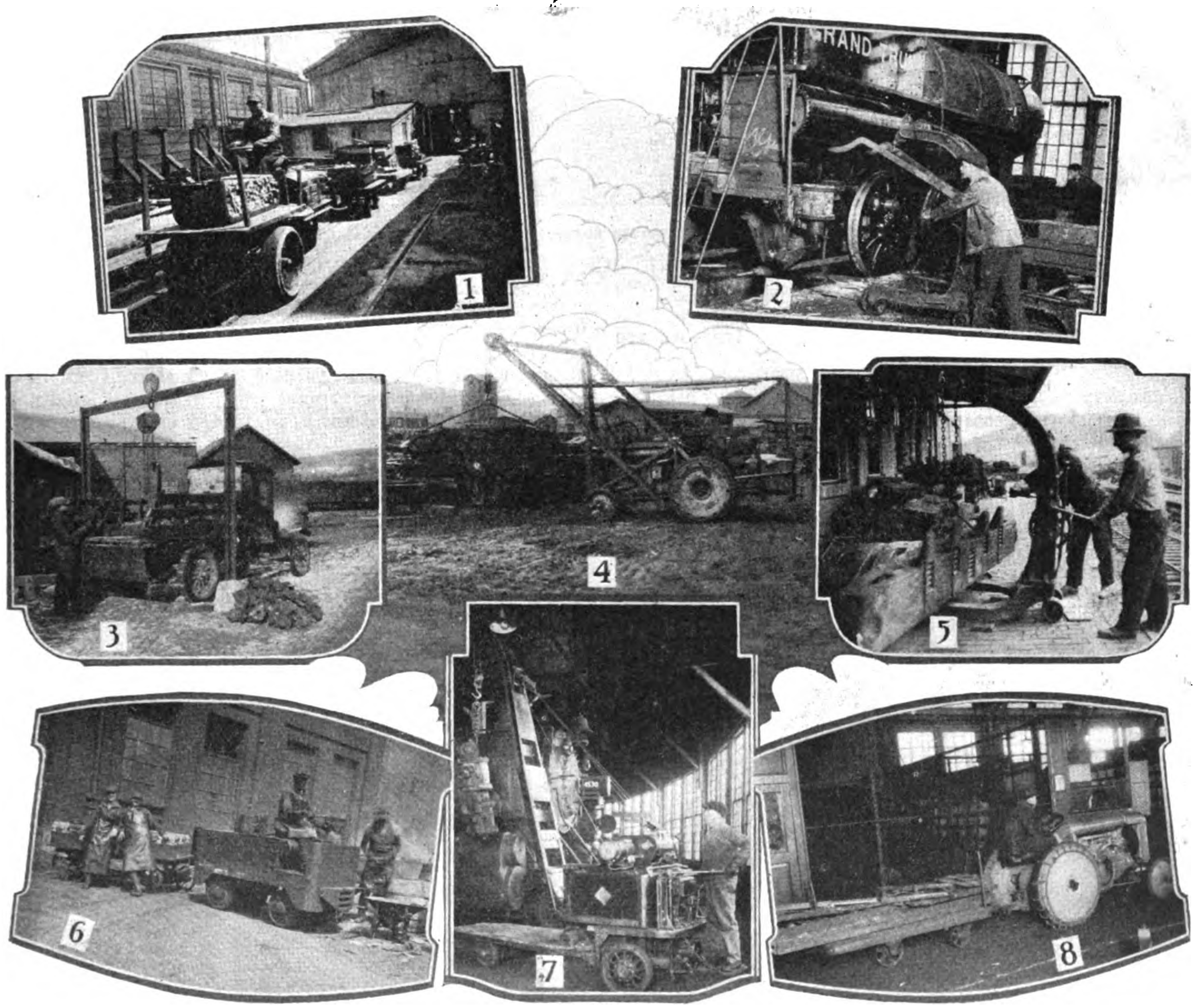


Fig. 1—Platform truck and trailers delivering material from the store room. Fig. 2—Crane truck equipped with auxiliary arm for applying main air reservoirs to locomotives. Fig. 3.—Loading car couplers on a truck with a chain hoist. Fig. 4—Rix-Fordson tractor handling material in a storage yard. Fig. 5—Crane trucks facilitate the work of handling heavy castings. Fig. 6—Truck and trailers running on a schedule speeds up production in the car shop. Fig. 7—Crane trucks equipped with long booms are of material assistance in erecting shop work. Fig. 8—Fordson tractor delivering material by trailer.

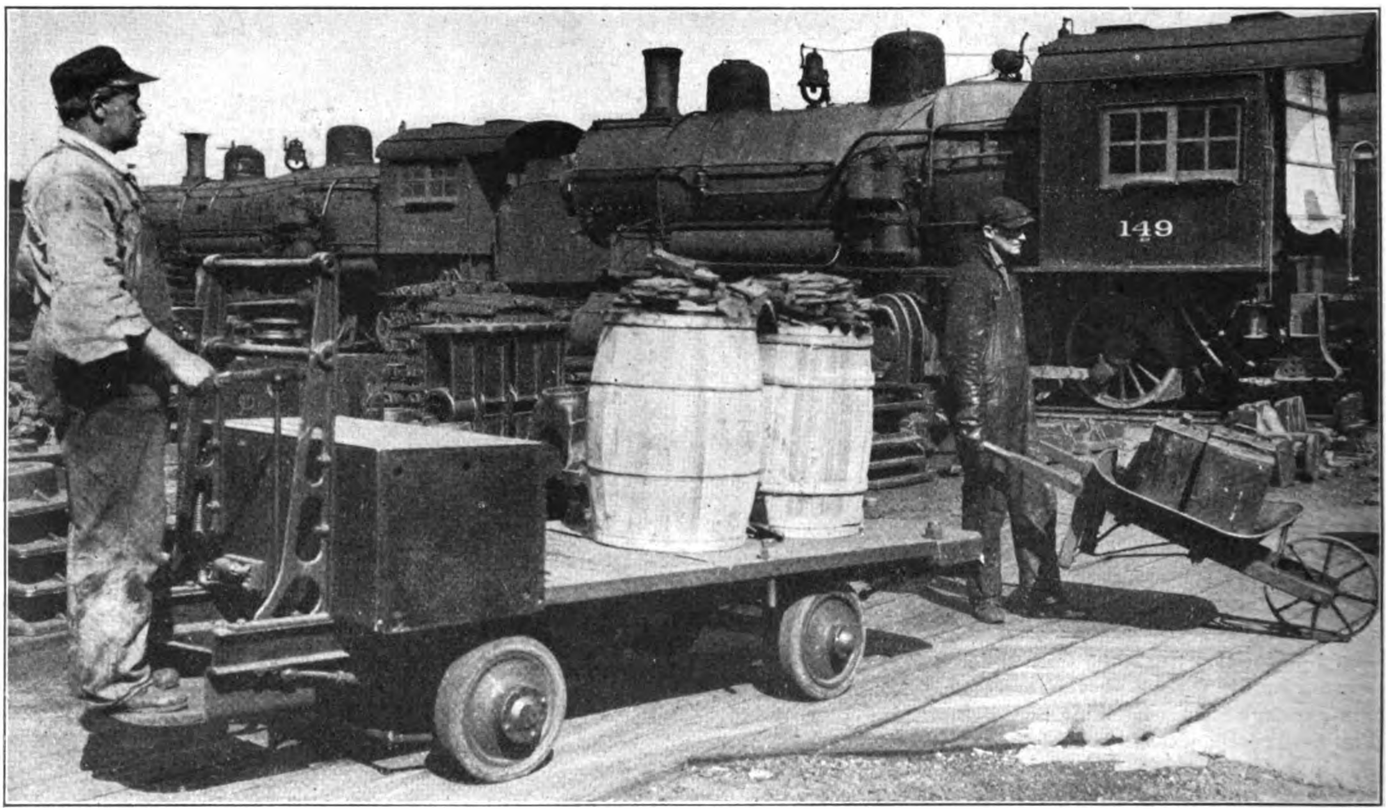
operates under the supervision of the foreman. This truck is available for transporting boxes to and from the foundry as well as material from the storeroom. For a description of the scheduling system used in these shops the reader is referred to an article by E. A. Koschinske, published elsewhere in this issue.

The ideal type of driveway for trucking material—A concrete surface has a tractive resistance of from 28 lb. to 40 lb. per ton

Many types of motor driven trucks and tractors are available

A variety of gasoline and electric driven trucks are now built to perform general and special service in railroad shops. A number of uses for different types of trucks and tractors are illustrated. The platform truck is built in various sizes with a maximum capacity of about 4,000 lb. The platform is usually from 20 in. to 24 in. above the ground and is designed primarily for service where the hauling is restricted to narrow aisles and runways. The low platform type has a platform about 11 in. to 17 in. above the ground and is best adapted for carrying heavy pieces, such as castings weighing from 150 lb. to 200 lb. The greater the weight of the pieces to be loaded the lower the platform should be to eliminate high lifting.

The elevating platform type is similar to the low platform, except that it has a movable platform which can be raised or lowered by a separate electric motor. The elevating platforms are built in various sizes and are from 10¼ in. to 17 in. above the ground when in lowered position. They have a lift of from 3½ in. to 4½ in. This type of truck has an advantage over other types of power trucks in being able to work more continuously. Standing time and extra handling are eliminated if the load is of such a nature that it can be carried on wooden or metal skid platforms. The platform end of the truck runs under the skid platform and elevates it and the truck then moves to



The old versus the new—An electric platform truck hauling material from the storage yard of a locomotive shop

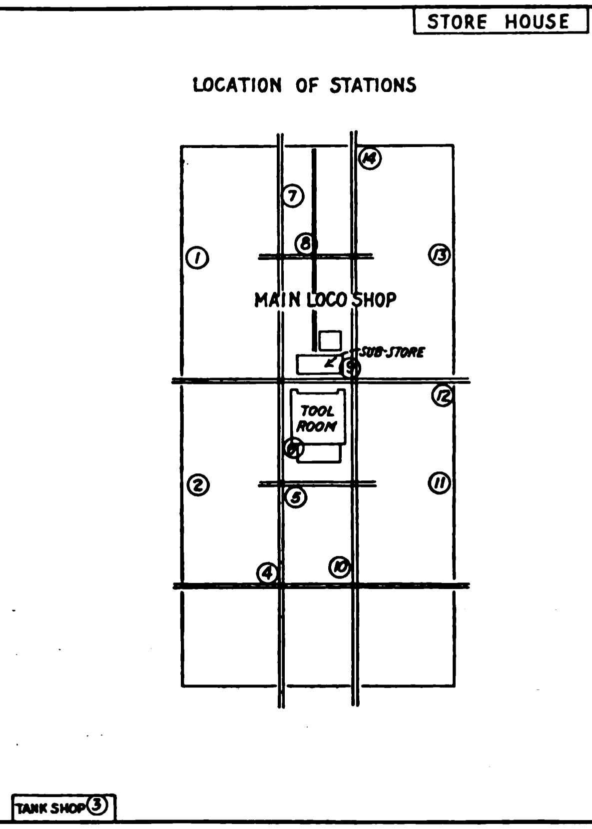
the desired location. The elevating platform truck is recommended where the volume of material to be moved and the length of haul precludes the use of the hand lift truck.

The tiering truck has many applications over a wide range and is similar in many respects to the elevating platform type. The lifting and driving devices are separated, but both can be operated at the same time if desired. This factor greatly facilitates the ease and speed at which this truck may be operated. It has the additional feature of tiering the load from 1 in. to 6 ft. or more, and can be used for loading boxes, barrels or bales onto automobile trucks or into freight cars. It can also be used to advantage for tiering in the store room and for placing heavy dies or stock in machines. It is recommended for use with skid platforms for hauling material and also for piling the loaded or empty skid platforms for storage. A useful accessory to this type is a platform with rollers. This platform is permanently fastened to the lifting arm and permits heavy loads to be easily pushed on or off when it is in an elevated or lowered position.

TIME TABLE

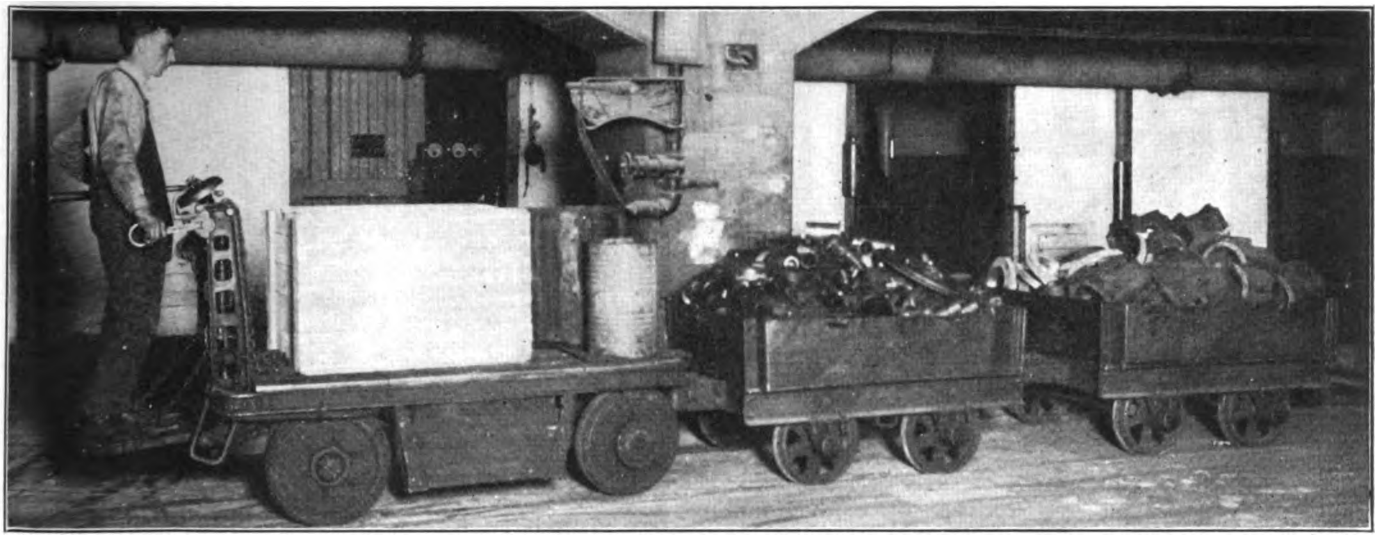
	STATION	TIME								
NO.	LOCATION	A.M.	A.M.	A.M.	A.M.	A.M.	P.M.	P.M.	P.M.	P.M.
	STOREHOUSE — Lv.	7:30	8:15	9:30	11:00	11:30	1:00	1:30	2:00	3:00
1	WEST BAY — PIT #47	7:35	—	9:35	—	11:35	1:05	—	2:05	3:05
2	WEST BAY — PIT #33	7:35	—	9:35	—	11:35	1:05	—	2:05	3:05
3	TANK SHOP	—	8:25	—	11:10	—	—	1:40	—	—
4	CAB SHOP - NOR. END	7:40	—	9:40	—	11:40	1:10	—	2:10	3:10
5	PISTON AND REPAIR DEPARTMENTS	7:40	—	9:40	—	11:40	1:10	—	2:10	3:10
6	ELECT. TOOL AND PAINT DEPARTMENTS	7:40	—	9:40	—	11:40	1:10	—	2:10	3:10
7	WEST MACH. BAY — NORTH END	7:45	—	9:45	—	11:45	1:15	—	2:15	3:15
8	AIR ROD AND MOTION DEPARTMENT	7:45	—	9:45	—	11:45	1:15	—	2:15	3:15
9	SUB STORE	7:50	—	9:50	—	11:50	1:20	—	2:20	3:20
10	BOILER AND PIPE DEPARTMENTS	7:50	—	9:50	—	11:50	1:20	—	2:20	3:20
11	EAST BAY - PIT #20	7:50	—	9:50	—	11:50	1:20	—	2:20	3:20
12	EAST BAY - PIT #15	7:55	—	9:55	—	11:55	1:25	—	2:25	3:25
13	EAST BAY - PIT #7	7:55	—	9:55	—	11:55	1:25	—	2:25	3:25
14	EAST MACH. BAY NORTH END	7:55	—	9:55	—	11:55	1:25	—	2:25	3:25

NOTE:- ORDERS MUST BE ON STATION HOOKS 15 MINUTES BEFORE TINE SCHEDULED FOR TRUCK TO CALL.
MATERIAL DELIVERED MUST BE REMOVED FROM STATION.
KEEP AISLES AND PASSAGEWAYS CLEAR.
DO NOT HOLD UP TRACTOR.



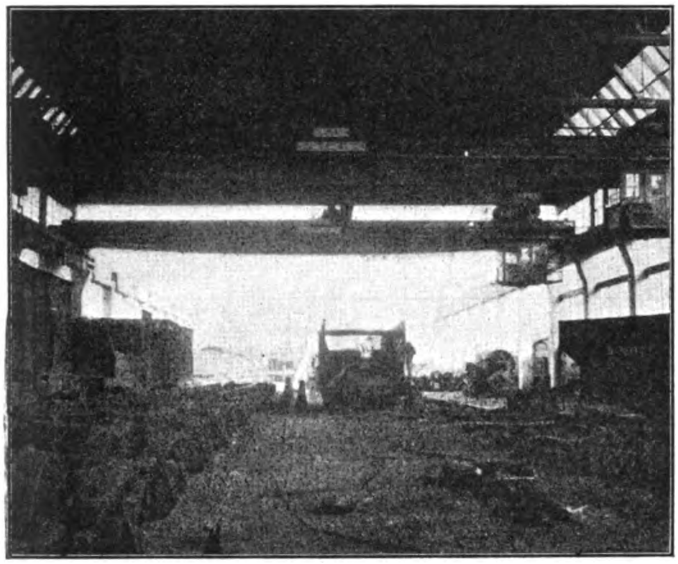
Storehouse and locomotive shop delivery system used at the Lehigh Valley shops, Sayre, Pa.

The crane type, applications of which are shown in some of the illustrations, is especially adapted to handling heavy weights in localities where the truck must move but short distances. Trucks of this type are equipped with either an electrically or hand operated crane of from



View in the subway of the Delaware, Lackawanna & Western locomotive shops, Scranton, Pa.—Handling scrap from the back shop to the foundry

1,000 lb. to 3,000 lb. capacity, mounted permanently or temporarily on the load carrying or low platform models. The compensating boom is equipped with a swivel base so that it will swing 90 deg. or more each way. The load may be carried on the hook or lifted by the crane to or from the truck platform. A modification of this type, equipped with a magnet attached to the hook on the

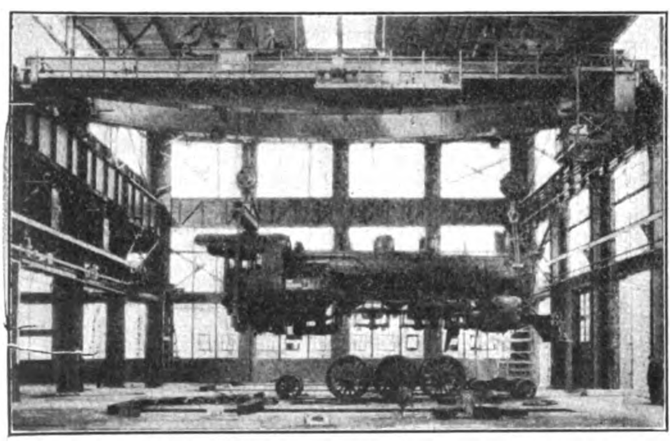


Overhead traveling cranes are generally used in car shops using the station-to-station system of repairs

crane, is useful for lifting castings, scrap iron or steel. Other modifications of this type are available, having a larger boom of stronger construction for heavier loads.

Gasoline engine trucks

Trucks powered with gasoline engines have a somewhat higher speed than the storage battery type and can be used advantageously in many places. Trucks of this

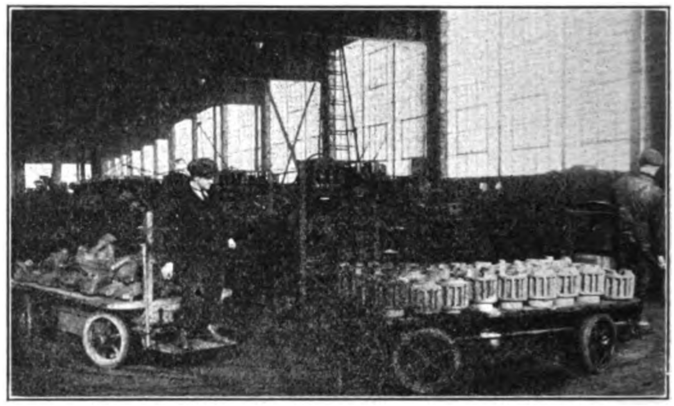


Overhead traveling crane service is a necessary part of the equipment of an erecting shop

type are designed with an average capacity of 2,500 lb. in the three-wheel type and 3,000 lb. capacity in the four-wheel type and operate at speeds varying from ½ m.p.h. to 12 m.p.h. They are especially adapted for interdepartment service where long hauls are involved and for out-of-door service. Gasoline engine trucks might be considered best applicable for hauls that would extend somewhat further than the usual hauling distance of the storage battery type.

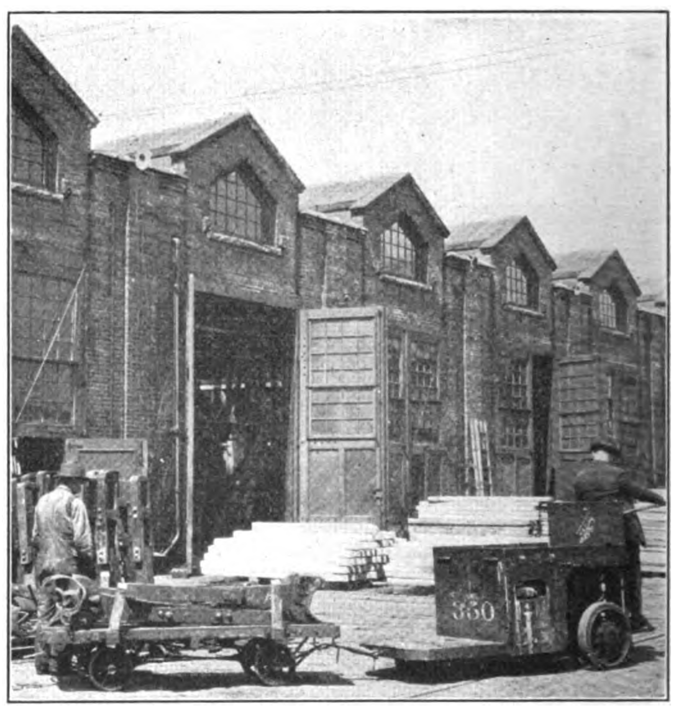
The installation of gasoline tractor and trailer methods for the handling of material in and about railroad shops has been of considerable assistance in solving the material handling problem of a number of important railroads. This type of motorized equipment will move material in large or small units, quickly and efficiently to any desired point. It eliminates the services of laborers with individual hand trucks and reduces the amount of material transportation required in modern railroad shops.

Typical examples of the successful use of tractor-trailer methods for efficiently handling material have been



Crescent electric platform trucks transportating small parts in a machine shop

described in past issues of the *Railway Mechanical Engineer*. At the Albuquerque shops,* of the Atchison, Topeka & Santa Fe, a trucking service has been installed using Ford tractors and trailers. This service is on a schedule run to all parts of the shop over a regular route. Material is picked up at any station and is carried to other



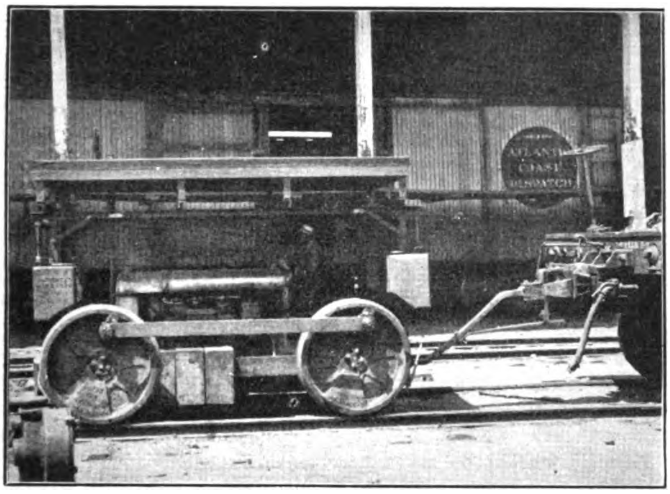
Low platform electric truck hauling a trailer loaded with couplers

stations at any point desired. Each column in the shop building has a station number and it is only necessary for the foreman to indicate on the order the station to which the material is to be delivered. One complete trip is made

*See the June, 1924, issue of the *Railway Mechanical Engineer*, page 233.

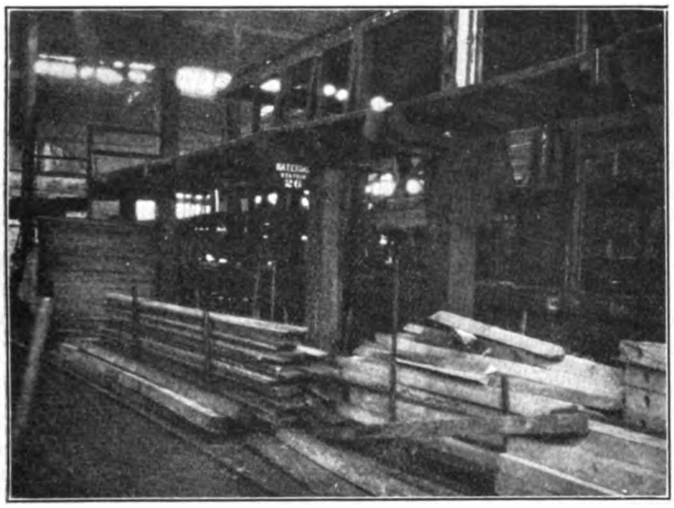
every hour to all parts of the shop. Fordson tractors and trailers are also used at the Finley shops of the Southern, Birmingham, Ala., for the handling of lumber and other material in and about the car repair yards. The Erie uses three power-driven trucks, two tractors and ten trailers in its locomotive shops at Kent, Ohio. This equipment supplies 400 workmen with material.

The interesting development of the tractor is the seem-



Fordson tractor equipped with flanged wheels for hauling scrap cars from the car repair yard to the power plant at the Rocky Mount, N. C., shops of the Atlantic Coast Line

ingly innumerable applications and uses to which it can be put. The fact that the Fordson tractor includes quite a number of standard Ford automobile parts, which are easily procurable, is perhaps one reason for its adaptability for alteration to suit a wide variety of service requirements. One of the illustrations shows a Fordson tractor which has been altered for rail service and is used to eliminate the services of a switching locomotive for handling scrap material from the car repair tracks to the power



Material station No. 26 in the car shop of the Lehigh Valley, Sayre, Pa.

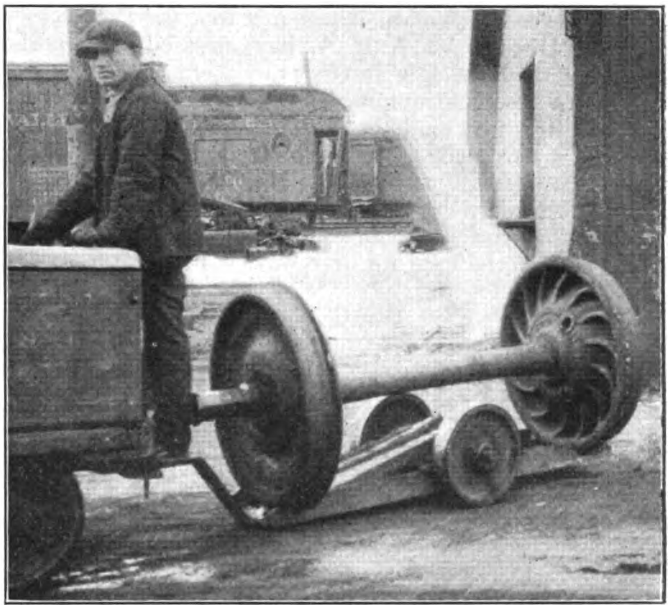
plant at the Rocky Mount, N. C., shops of the Atlantic Coast Line. This tractor, coupled to two or three flat cars, is moved about the yard at the convenience of the shop forces and all wood scrap material is loaded on the flat cars and taken to the power plant where it is burned.

Many types of trailers have been developed throughout the country for handling different kinds of material. In all probability the car department is the worst offender in not adopting standard types of trailers. It would seem that standard trailer types could be developed for car department use more easily than for the locomotive department, owing to the fact that there is a less variety in the shapes of material to be handled. As a rule, trailer trucks are built in the shop and are not purchased from the manufacturers of material handling equipment. For this reason it would seem logical that the car department make a study of the best type of trailer truck to be used for certain services and then adopt it as standard.

Cranes, conveyors and overhead carrying systems

Cranes are grouped into several classes, such as overhead, travelling, gantry, jib, locomotive and roof cranes. The advantages of cranes as labor saving devices are well recognized and the benefits derived from their use have led to their wide application in railroad shop work.

The average locomotive repair shop comprises from eight to 10 major departments. The number of men em-



Two-wheel trailer truck used at the car shops of the Lehigh Valley, Sayre, Pa.

ployed and the amount of equipment installed depends largely on the number of locomotive repair pits in the main erecting shop. Certain class repairs to locomotives involve removing of practically all accessories and machinery parts and transporting them to the various departments. Practically all of this work is performed by overhead travelling cranes, the fundamental operations of which are well understood. Another use of overhead travelling cranes, and quite often gantry cranes, is in car shops where the station-to-station system of repairs is used.

There are, however, many shops and engine terminals in which the operation could be considerably improved by the installation of more adequate crane facilities. There are times in every enginehouse when speed is a vital necessity. The availability of overhead crane facilities as well as jib cranes is important at such times. Application of crane service to a number of locomotive and car repair jobs are shown in the illustrations.

Overhead carrying systems, such as the mono-rail, find more extensive utilization in the store room than in the locomotive shop. Stores departments that have large quantities of material to handle, have found a mono-rail system quite convenient in handling material from the piles or bins to the car door or loading platform.

The use of conveyor systems in railroad shops is confined primarily to power plants and to coal and ash handling at engine terminals. Some of the applications of conveyor systems to railroad shop work are also illustrated. From the standpoint of efficient engine terminal operation considerable delay can be avoided through the provision of adequate coaling and ash handling equipment. Conveyors of several types have been used successfully for unloading material from freight cars at the storeroom. A roller conveyor, consisting of wooden rollers turning on ball bearings, is being used by the Erie at a number of points on its system. In this conveyor the rollers are placed close together in a frame extending from the car to the place where the material is deposited. A slight incline from the car to the platform is sufficient to carry the material by gravity to the end of the conveyor. Corners can be turned quite successfully and for such work as moving packages, arch brick, etc., this type of conveyor is quite satisfactory.

Conclusion

Both the Mechanical Division V and the Purchases and Stores Division VI, A. R. A., have stressed the importance of providing not only an efficient system of material handling but adequate equipment as well. As a result there are few new shops built at the present time in which provision is not made for efficient handling of material. Old installations have also been improved through the installation of modern handling equipment and improved driveways for trucks, tractors and trailers.

The material used for driveways is important. Given in the table is the resistance per pound of moving load for various driveway surfaces. Concrete surfaced driveways give the least resistance to hauling and are coming into general use around railroad shops.

The utilization of cranes of practically all types is well understood as they have been an important part of railroad shop equipment for a good many years. Still many new applications, especially in the line of special types of equipment, have been developed in recent years that have tended to increase the services that may be performed by cranes in railroad shop work. The work that can be performed by trucks, tractors and trailers on hard surfaces has a wide range and new uses for such equipment are constantly being devised. These developments have tended materially to reduce the difficulties encountered in handling material due to a poor shop layout or inability to add fixed and less flexible facilities to the shop equipment, and have been a big factor in procuring increased shop efficiency.

Tractive resistance of various surfaces

Type of road surface	Resistance (Lb. per ton)
Brick, smooth	30 to 50
Concrete	28 to 40
Poor concrete	45 to 65
Granite blocks	50 to 60
Wood blocks	30 to 50
Gravel road, good condition	75 to 85
Clay	200 to 400
Wood planking	35 to 50
Wood planking, sticky surface	50 to 60

Welding high carbon tool and high speed steels*

By George L. Walker
Associate research engineer, Air Reduction Sales Company, New York

THE welding of high carbon tool steels and high-speed steels has an extensive field for development and one that has already met with considerable success. There yet remains a need for further study and development in methods and materials before these steels are as successfully and as extensively welded as are the lower carbon steels.

It is difficult to give a hard and fast rule for welding high-speed steels that will meet every demand. The piece that is to be welded, its design and purpose for which it is to be used as well as the chemical characteristics of the metal within the zone of welding, have an important influence on the welding procedure. The experience of the welder also must be considered. There are, however, some rules to be observed in welding these steels that are almost fundamental and which must be followed if any degree of success is to be realized.

High carbon tool steels are those steels containing from about 0.60 per cent carbon to 1.50 per cent carbon, and it is by reason of this high carbon content that they can be hardened and tempered and thereby serve in the cutting of metals. Such tool steels are used principally in making tools of various kinds, such as milling cutters, drills, reamers, files, lathe tools, saws, hammers, wrenches and for many other purposes where a tool possessing hardness and resistance to wear or abrasion is required.

High-speed steels are those steels of comparatively low carbon content which depend for their hardness on the use of tungsten and chromium. They also contain other metals, such as vanadium, cobalt, manganese and molybdenum. Such steels are used in making all kinds of tools, especially lathe and shaper tools, milling cutters, drills, reamers, and for all purposes where great efficiency, high-speed cutting and heat-resisting qualities are required.

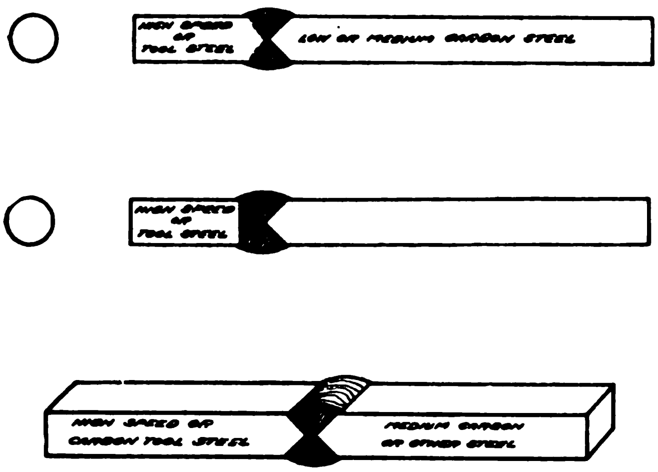
Importance of carbon content in tool steel

In the welding of tool steel the carbon content is an important factor to consider. A steel with a carbon content of from 0.60 to 0.85 per cent may be welded fairly easily by a welder who exercises ordinary care and is at all familiar with steel welding. With a carbon content of from 0.85 to 1.00 per cent the welding is more difficult, and from 1.00 to 1.50 per cent great care is required in making a weld—a degree of care that can only be attained by experience in welding steels with such high carbon content.

All metal cutting tools are subjected to a number of stresses, all of which are important factors in the proper

* Abstract of a paper presented before the New York Section, American Welding Society, May 18, 1926.

selection of the steel for the tool and also because of their effect on the welds. Drills, reamers and taps are subjected to torsion and to tension stresses. Lathe and shaper tools are subjected to transverse stresses. Milling cutters have to endure nearly every type of stress. The cutting edge of all metal cutting tools must not only have good wearing qualities, but because of its extreme fineness and its functioning in the cutting of metals must endure practically every stress. It is because of this fact together with the welding qualities of the metal that the welding of carbon tool steels and high-speed steels be-



Top—Welding high speed steel bits to medium carbon steel shanks for reamers and other tools; Bottom—Welding high speed or carbon tool steel to medium or other steel

comes a problem that has been harder for many welders to solve than the welding of mild carbon steel.

Both high carbon tool steels and high-speed steels have been and are now being welded successfully. In reclamation and general repair work much has been accomplished in such work as building up the faces of hammers worn and chipped in use. Wrenches with broken or worn jaws are being reclaimed. Milling cutters and reamers with broken teeth are repaired. Form tools are being reclaimed by building up the worn part with high-speed and tool steel and regrinding to shape.

Lathe tools for use in heavy cutting are being made by welding a high-speed steel bit to a medium carbon shank. Reamers are also made in this manner. Milling cutters and other steel cutting tools have been made by building up the cutting edge on a low chrome or medium carbon steel center.

Another use for both high carbon tool steel and high-speed steel is for building up parts of machinery, and so forth, which require a hard, erosion-resisting surface. In the welding of high-speed steels I wish also to include stellite, an alloy of cobalt, iron, chromium and tungsten which is used for similar purposes as are the high-speed steels.

Torch, tips and flame adjustment

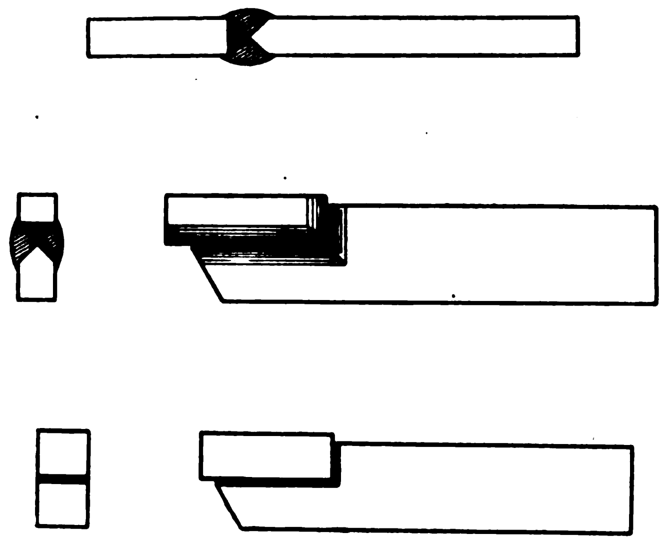
Among the main requisites in welding high carbon and high-speed steels are the torch and tips. They should be of a construction that will assure a good mixing of the gases before burning and a low gas ratio. Torches of this type are available.

The flame adjustment is also important. It should be a reducing flame for high-speed steels, stellite and the higher carbon steels. With the carbon steels this flame adjustment somewhat depends upon the carbon content. The lower carbon tool steels may be welded with a neutral flame, taking care that it is non-oxidizing. The higher carbon steels, however, require an excess of acetylene in the welding flame. It is difficult to describe the exact flame characteristic. Experience only can tell the welder the flame desired. It will vary slightly with the type of steel being welded.

The welding rod is also important. In the high carbon steels it should be of high-grade material, and not lower in carbon content than the steel to be welded. If the welding metal is to become part of the cutting edge it is preferable that the steel contain a slightly higher carbon content. This, however, is less important than that it be at least of as high a carbon content. Any great departure in the carbon content from that in the steel to be welded will make the welded metal either too soft to take the proper temper in the heat treatment, or too brittle to withstand the stress to which it will be subjected in use. There are many welds that can be made in tool steel where a much lower carbon steel can be used. This must be determined by the functioning of the tool itself, as these welds are at a point remote from the cutting edge.

In preparation of the part to be welded a rather wide bevel on tool steel is preferable. This will make unnecessary the fusing down of the sides in making the weld. All parts to be welded should be carefully cleaned of dirt and rust.

The welding of high-speed steels in general is not dissimilar to welding high carbon tool steel, requiring the same method of preparation and a welding rod that will flow freely and not cause blowholes. Heavy oxides from the chromium and tungsten usually form on the surface



Top—Method of welding high speed tool bits to soft steel shanks for lathe and shaper tools; Bottom—A method of brazing high speed steel bits to medium carbon steel shanks for lathe tools

of high-speed steels in the melting operation, and blowholes become difficult to eliminate. It will be found advantageous to use, wherever possible—and it is usually possible—a high-speed steel filler rod containing vanadium and cobalt. These steels flow freely and very cleanly. I do not mean to infer that this steel is a better high-speed steel than any other as undoubtedly each type of steel has its important field. I refer to its weldability only and value as a filler rod.

The tip for welding all tool steels should be from one to two or even more sizes smaller than should be used for the average steel of the same dimensions. This,

however, is controlled somewhat by the nature of the weld and the skill of the operator. But in general this rule holds good.

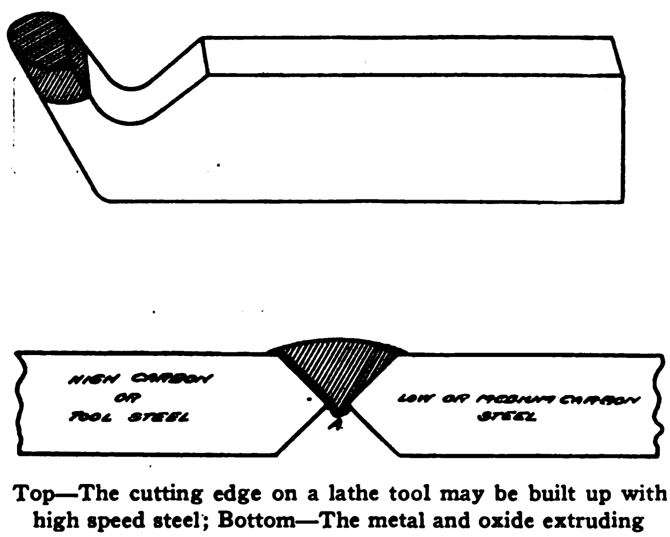
A flux is of great aid in welding tool steels; in fact, it is almost necessary in order to make good sound welds. A good cast iron flux will give good results on carbon tool steels. There are fluxes on the market that have been developed for tool steels.

Precautions to be observed

One of the main precautions to be observed in welding all of the tool steels is to take care not to overheat the welded metal. Do not use any more heat than is necessary. Another precaution is not to rework the welded metal unnecessarily. Deposit the filler rod in thin layers when the base is ready to make a weld. Add the metal just fast enough to prevent it from flowing over where the base is not in a welding condition and then let it remain there and add more filler rod. Continue in this manner until the weld is completed. It is the frequent reworking of the weld metal that causes the most of the defective welds. It causes blowholes, and creates an excessive film of oxide that collects on the surface. The success or failure of the weld depends on properly adding the filler rod.

When the welded joint is of the double vee type there will be some metal extended through the bottom of the vee when the first half of the weld is completed. This extended metal is composed to a great extent of oxides. It is better to remove this extended metal before starting the second half of the weld either by flowing it out of the vee with the torch or by any other means that will remove the oxide and prevent an excessive accumulation of it in the weld.

The high-speed steel should not be melted down in making a weld, but rather the filler rod should be added to the surface, taking care, of course, that the surface is



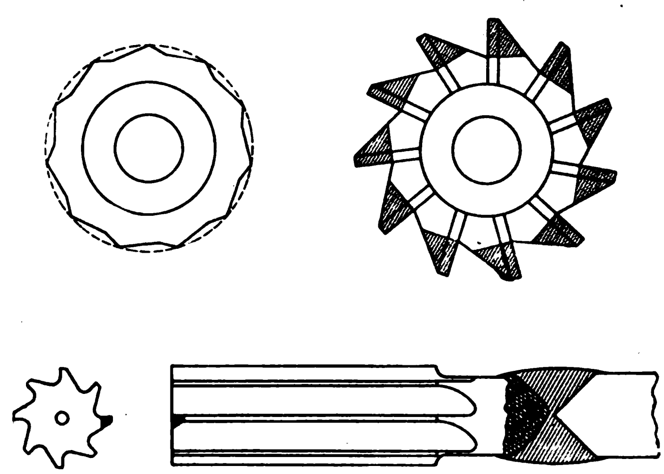
Top—The cutting edge on a lathe tool may be built up with high speed steel; Bottom—The metal and oxide extruding through the vee at A should be removed before welding the opposite vee

in the proper state of fusion to take a weld. For this reason a wide bevel is of great advantage. The bevel should not be less than 45 deg., and the combined vee not less than 90 deg.

Where a carbon tool steel or high-speed tool steel bit is welded to a medium carbon steel shank or base and it is not desirable or practicable to bevel the bit, it is best to prepare the bit first by building up over the surface a conical or beveled section with the filler rod. The filler rod should be of nickel or vanadium steel in a weld of this type. However, other steels may be used as the filler. The bit is then placed in position on the shank or base and the same filler rod used to make the weld.

I have seen many failures in making these welds when the bit was not prepared in this manner, but have always met with success when the bit has been prepared as I have just described. This type of weld is used on special reamers, heavy lathe and shaper tools, and so forth.

Lathe tools of the forged carbon tool steel type have been modified by building up the cutting ends with high-speed steel along the lines in the illustrations showing the lathe tool. Milling cutters have not only been repaired by building up broken teeth, but new cutters have been made by using a low chrome steel center and building up the teeth with the oxyacetylene flame. As an aid in this work a form or mold was made of graphite, approximating the shape of the teeth. The cutter base was mounted on a shaft or arbor so that it could be turned readily. The form was held in place and the weld made by carefully fusing the base and then filling up the form. These cutters were made in a short time and were suc-



The top view shows method of building up teeth on a milling cutter and the bottom view shows how a broken tooth on the end of a reamer may be built up and also the method of welding a broken shank

cessful. The filler rod was a cobalt high-speed steel. No heat treatment was required after welding. The cutter was ground into shape and put in service. In a test for comparison with a similar cutter made of high-speed steel by the casting process and a forged high-speed steel cutter the welded cutter gave approximately 60 per cent greater efficiency than the forged cutter, and about 30 per cent more than the one made by casting. The cutters used in the tests were 6 in. in diameter with a 1-in. face. The cut was 1 in. deep and was run at the highest speed possible. Identical results were obtained by the lathe tools built up as described.

Hammering of the weld after completion must be done with caution. It is beneficial to a weld in the carbon tool steels where the parts welded together and the filler rod are of the same composition, but where any part, including the deposited metal, is of a different type of steel or even of the same type, but considerably different in carbon content, hammering should not be attempted. Hammering of a weld where carbon tool steel is welded to low or medium carbon steel or to high-speed steel or where high-speed steel is welded to any other type of steel will cause the joint to break apart due to the difference in malleability of the metals. Many failures in welding these steels can be attributed to hammering the weld.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Combustion the basis of front end design

SCHENECTADY, N. Y.

TO THE EDITOR:

Comment on front end design frequently implies that nothing rational has been done about the exhaust and front end problem and that a need exists for formulating the requirements for this feature of the locomotive.

In my study of this problem I have come to the following general conclusions: The exhaust and stack should be regarded as functioning with respect to the amount of fuel burned. This might be modified by taking account of the amount of steam formed but considering the steam formation as having a close relation to the amount of fuel burned, it serves no practical end to give it separate value. This, especially in view of the variable rates of combustion and steam requirements, can not be calculated too closely.

Primarily, I consider the jet to be one element and the stack another which should be proportioned to produce an ejector effect. With small locomotives this is a simple matter. The jet can be positioned far enough below the stack to catch the gasses and the stack can be of a length and flare that will produce efficient draft with no objectionable choking of the nozzle. When the locomotive reaches the clearance limit for the height of the stack together with the increased size of boilers, the present conditions are produced, with a stack which is mostly within the smoke box. When such conditions exist the proportions of the small locomotives cannot be retained. To offset this difficulty, the stack has to be relatively closer to the nozzle and the diameter must be reduced. The idea is to use the same size of cone as would develop into the proportionate size of stack that would be used if the clearance height were 40 ft. or 50 ft., instead of 15 ft. The ratio of the diameter of the boiler to the length should be kept within such limits as will not cause the loss of draft to be excessive. I think it has been shown that it should be 3½ diameters. Similar conditions require the exhaust to be sharper on account of the relatively close location to the bottom of the stack.

I have assumed a sliding scale of area of tip in relation to the total amount of steam flowing out which favors the small locomotive but does not change greatly from it. The stack diameters, owing to the great restriction imposed by the clearance height does not increase as fast as the outflow of the products of combustion and the greater portion of the taper lies within the smoke box. It is not difficult to do this and there appears to me to be no necessity for making the stack "extension" within the shell cylindrical, simply because it must be parted up near the top inside. Any locomotive requiring such a design of stack will permit sufficient variations in height at the bottom end without affecting the diameter, if only a foot or so be made without a taper.

I do not believe that the size of the cylinder need be taken into consideration. The proposition I make permits the size to be established with equal facility whether steam be used in cylinders or in a turbine, wherefore I consider it logical. A series of sizes has been worked out based on the general proportions of existing locomotives but using combustion as a basis without respect to the incident of cylinder diameter.

I wonder if others have used similar assumptions?

FRANK F. SCOVILLE.

Progressive car foreman should educate his car inspectors

DENVER, Col.

TO THE EDITOR:

In the editorial in the June issue, entitled "The car inspector's judgment," I heartily agree with the statement, "Improve the car inspector's judgment by careful training and frequent checks."

But why is it that so few car foremen are carrying on educational work among their car inspectors and the men who are to be their future car inspectors?

If we observe the work of the car department as I have through about 20 years of actual experience, I think that we can come to but one conclusion: that is, where we find the car inspector receiving the educational training so very necessary for his success, we find a progressive car foreman thoroughly experienced and up to date in car work. He realizes the fact that to make his own job a success by saving time and money for his company, he alone must educate his car inspectors to use expert judgment at all times.

You may ask, "what about the car inspector that education will not bring to the point where he can use expert judgment?" There are many car inspectors who were not cut out to use judgment and to assume the responsibilities required for a car inspector. So the progressive, experienced, live wire car foreman is the answer again. He soon locates through education and observation those men who are not fitted for car inspectors and places them on jobs of lesser responsibilities. If the higher railroad officers, in hiring and promoting car foremen, will first use some of this expert judgment themselves, the railroads will soon have plenty of car inspectors who can and will use expert judgment at all times.

In conclusion, I want to add just three questions on A. R. A. rules—practical questions from the ten to twenty that our chief and assistant chief joint inspectors figure out and put to their interchange inspectors every thirty days.

1—In handling a car with rider protection, if the hand brake becomes defective or inoperative before or during the switching operation and the car is damaged to the extent shown in Rule 44, who is responsible, the owner or handling line?

2—If a car is damaged on an incline track or wharf where rider protection is not furnished, who is responsible, the owner or handling line?

3—To what extent must a car be damaged where there is no rider protection when necessary, to make the damage a handling line responsibility?

A READER.

"Bill Brown" and "Top Sergeant"

BATTLE CREEK, Mich.

TO THE EDITOR:

You may be interested in the comments of my father, who lives in Stafford, England, on the "Bill Brown" controversy. Following is his reaction, quoting a few of his remarks in his own language:

"As I am over 70 years of age, my interest in the marked articles sent by you was mostly confined to the ever-changing relationship between employer and employee, or foreman and workman. Here 60 years ago a foreman was an autocrat, who ruled by the strength of his arms and it is more truth than fiction to say that he was invariably chosen for his fighting ability, knowledge of his job being only a secondary consideration. A suggestion by one of his men was always an insult and resulted in either a race or a fight.

"Looking back on those days, I must admit that the best results were often obtained by the best fist fighter and the best workers would invariably be found in his gang. Saturday nights the men would get together at some nearby saloon and boast about some feat of strength, or probably some brutal action their foreman was responsible for during the previous week.

"This was the type of workmen of that period and it is possible that the strong arm foreman was essential at that time. If 'Bill Brown' had been a foreman in those days and had requested instead of demanding, he would soon have been dubbed not 'Reverend' but 'Mrs. Brown' and would undoubtedly have lost both his prestige and the respect of that type of men.

"Compulsory school education was the main factor in pulling the teeth of the 'strong arm.' Our boys were taught to think for themselves. They began to write and express their thoughts intelligently to their fellow workers all over the country. The result was nation-wide organization, which has been instrumental in bringing him up to his present place in the sun.

"The time is approaching, if not already past, that class organization has outlived its usefulness. Note the tremendous losses to both sides, also to the public, in general, that have occurred in most of the industrial strikes during the past year or so. The result is that the contending forces have drawn a little further apart or distrust for each other has arose and the best intentions from either side are looked upon with suspicion.

"'Bill Brown' has recognized this deplorable condition and is paving the way to allay that suspicion by laying his cards on the table face up, admitting his weaknesses, recognizing both their weakness and strength, and seeking their co-operation.

"Education has taught the worker his power and he is going to use it for his own benefit. 'Bill Brown' also recognizes that power and he is going to use it for their mutual benefit.

"'Top Sergeant' is the type of foreman I am well acquainted with. He is trying to copy the strong-armed, stout-hearted foreman of 60 years ago, but look under his thin hide and you will find him only, what you call in America, 'a bluff.' We had him for a foreman on a tunnel job on the N. S. Railway. We were in about 1,000 yards when water began to soak through from an old abandoned coal mine. 'Top Sergeant' was appealed to for protection from caving by re-enforcing the side walls, but of course he ignored our appeal, drove us back to work by threats of discharge and told us we were paid for doing the work and he would do the thinking. However, he stooped low enough to tell us there was no danger, as he had figured it all out on paper.

"There was one man in the gang who was gifted with a sense of humor that often got him into trouble. He it was who connected a hose to a donkey pump and as 'Top Sergeant' was passing the weak place, turned a full flow of water on him. Poor old 'Top Sergeant' beat all known records getting out of that tunnel. Although he must have soon realized the trick, he never came back. His bluff had been called.

"Your 'Top Sergeant' will soon have his bluff called and he will never come back. Sixty years ago there was some excuse for his existence. Today, it is 'Bill Brown's' turn. Even if we give 'Top Sergeant' the benefit of the doubt and give him credit for giving all he is capable of to his job, what chance has he against 'Bill Brown' who is giving his best with the addition of the best that the men have who are working for him?" "OUTPUT."

A question on the Walschaert valve gear

ST. JOSEPH, MO.

TO THE EDITOR:

If the pin should break or fall from the union link of a Walschaert valve gear, the locomotive running at a speed of 40 m.p.h., would the steam pressure in the cylinders cause them to break?

Such an instance of cylinder failure occurred on a locomotive operating in passenger service on the road with which the writer is connected. New cylinders, 19 in. by 36 in. had just been applied. I would like to have the opinions of the readers of the *Railway Mechanical Engineer* as to what might have caused this accident.

C. M. LEE.

Locomotives equipped with the Brotan firebox

GALVESTON, Texas.

TO THE EDITOR:

On page 212, in the April issue of the Railway Mechanical Engineer, Louis A. Rehfuss refers to the possibility of a water-tube boiler displacing those of the usual locomotive type.

In principle, as well as in many details of construction, there is no difference between the latest form of the Brotan firebox and the McClellon and Muhlfeld designs now undergoing tests in the United States. It is evident, however, that Mr. Rehfuss is unfamiliar with the history and status of the Brotan type of firebox in Hungary. Instead of the 40 or 50 Brotan type boilers mentioned by him, there were at one time more than 600 boilers equipped with the Brotan water-tube firebox in use on the Royal Hungarian State Railways.

Among the classes of engines fitted, were the following:

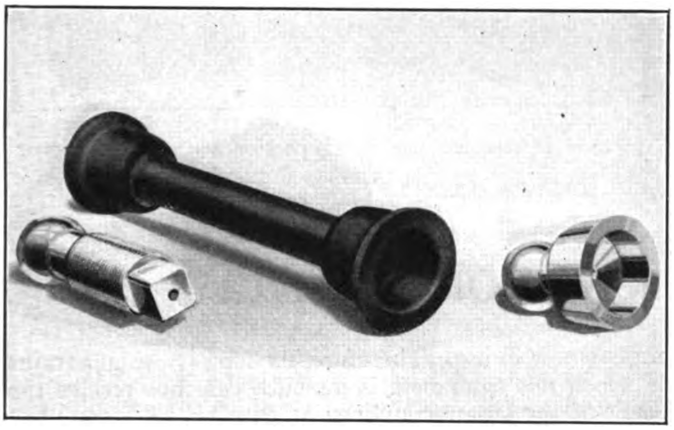
Number of locomotives	Series	Type
60	601	2-6 + 6-0 Mallet
158	328	4-6-0 Express
145	375	2-6-2 Tank
78	376	2-6-2 Tank

In addition to the above, the Brotan box was adopted as standard for at least eleven other classes of locomotives, ranging from the small 2-2-0 tanks to heavy 2-8-2 tank locomotives and the 2—4 + 4—0 Mallets.

As an indication of the practical results obtained from this large scale experiment, it is significant to note that when ten additional engines of series 376 were built in 1922 and 1923, water-tube fireboxes were not applied, and in 1924, 26 heavy 4-8-0 type express passenger locomotives of series 424 were constructed with ordinary radial-stay fireboxes. WILLIAM T. HOECKER.

Pitkin articulated staybolt

WHEN the rigid type of staybolt was most generally used breakage was found near the outer sheet. This condition was because of the fact that the outer sheet, being heavier, held the end of the bolt in a rigid position, thereby throwing the greater strain on the bolt at its junction with this sheet. The inner sheet, being of lighter weight, took up some of the strain by bending, thus partially relieving the bolt at the inner rigid connection.



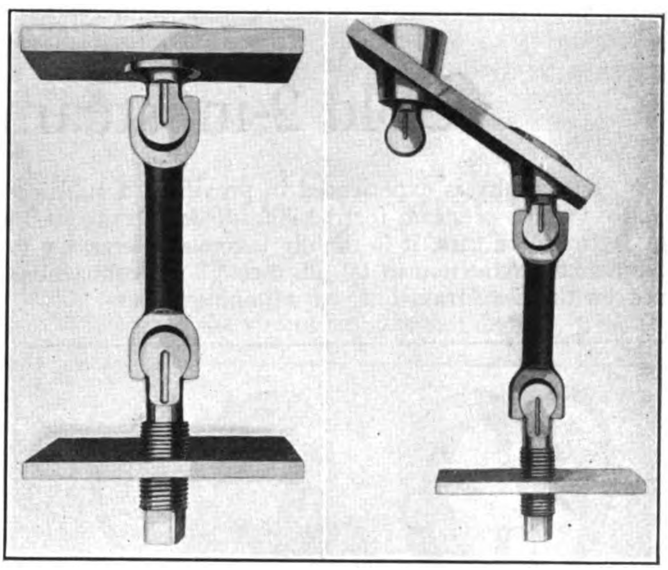
This view shows the middle member with its two sheet connections before assembly

This is the condition that brought about the development of the flexible staybolt. By the use of a flexible ball and sleeve type bolt the strain at the outer sheet was greatly relieved. However, the slightest movement still throws a strain on the thin inner sheet. The continued uneven expansion and contraction of the inner and outer sheets constantly changes their position in relation to each other. This movement causes the bolt to "bell" the hole on the water side, thereby exposing the thin threads to the oxidizing effect of the water.

The scale that forms around the bolts is also broken away by this weaving motion and fresh surfaces are exposed for attack. In time minute checks or cracks appear radiating from the bolt and finally the sheet is materially eaten away immediately around the bolt connection. This process continues until it becomes necessary to replace not only the bolt but also the sheet.

To relieve this condition it is necessary to provide means whereby the bolt connection to the firebox sheet can be held rigidly fixed therein and still have no weaving or bending strains set up at this point. In order to accomplish this result The American Locomotive Company, 30 Church Street, New York, has developed the Pitkin articulated staybolt.

One of the illustrations shows a partially sectional view of the bolt in order to show the reinforced bearing faces in the ends of the sockets as well as the expansion spaces in the sockets over the balls. Expansion stays have larger expansion spaces over the balls than water space bolts.



At the left may be seen a partially sectional view of the bolt showing the reinforced bearings in the ends of the sockets —The right view shows a staybolt applied to a sheet with a maximum slope of 32 deg.

The connection at the outer sheet is a hollow tapered plug with a tell-tale hole drilled into the ball. A tell-tale hole is also drilled through the center of the inner threaded connection into the ball at this end of the bolt. The main bolt body and sockets are made substantially stronger than the end connections into the sheets, so that if a break

should occur, it would be immediately apparent through one of the tell-tale holes in the end connections.

Any movement of the articulated bolt body will only cause it to rotate around the ball located close to the thin sheet. By thus taking up the flexing strains set up by the relative expansion and contraction in the wrapper and inner firebox sheets, the life of the firebox sheets should be prolonged. As the actual movement between the outer and inner sheets is slight, the angular pull on the inner ball connection of the bolt is considered of no practical importance. This slight movement, however, will be sufficient to keep the joint free from the scale deposit which in some cases has transformed the semi-flexible into solid bolts.

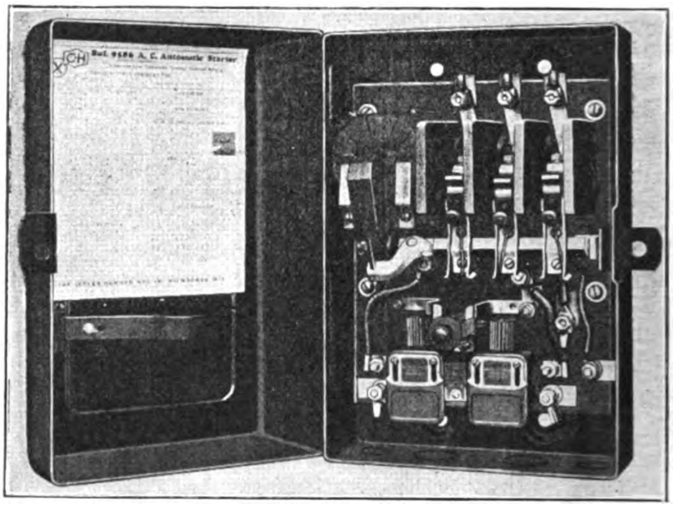
Across-the-line starters for A. C. motor drives

THE Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has completed the design of an automatic starter for use in connection with alternating current motor drives, requiring motors of small and average capacities which can be connected directly across the line and provides complete motor protection.

These C-H "X" starters embody such features as small size, ruggedness of the switch mechanism, thermal overload relays, accessibility, and roominess in spite of the small size, low-loss magnet construction, easy installation and a wide range of application.

The type "A" starter in the "X" series is a fully enclosed starter and employs a positive acting three-pole contactor, together with a thermal overload relay. This relay is extremely accurate, can be adjusted to individual motor loads, and is of fool-proof design. After it has been tripped by an overload it is reset by pressing the reset button without the need of making any replacement. The contact fingers employed are easily accessible for inspection without the use of tools, and can be easily renewed. It is not necessary to take the starter from the case nor dismantle it.

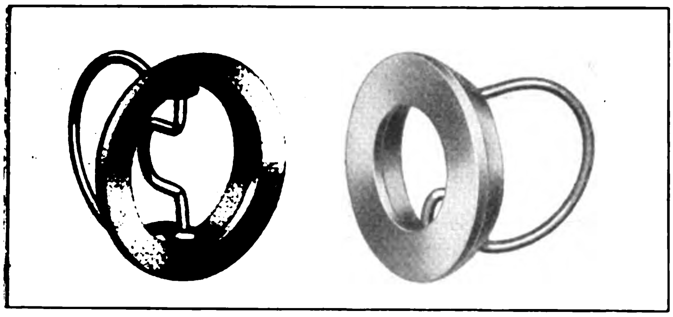
One starter takes care of all motor sizes, since only the heater coils need be changed to suit the ampere rating of the motor.



Automatic starter for use in connection with A. C. motor drives

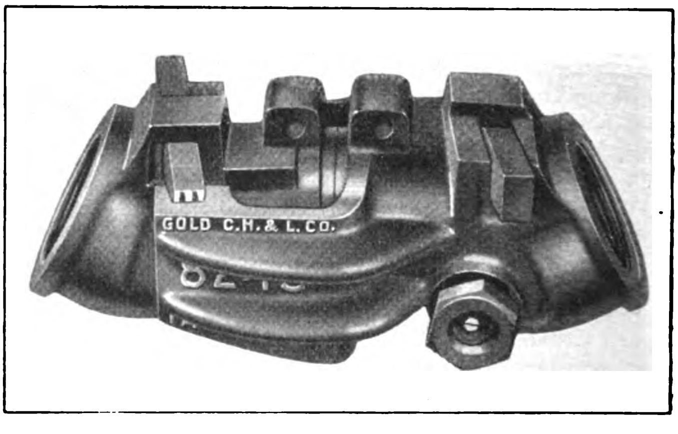
Gold 2-in. steam hose connection

AS difficulty is experienced in providing a sufficient volume of steam for the long modern trains of 14 or more cars, it is rapidly becoming necessary to eliminate the reduction to 1½ in. through the connections between the 2-in. train lines of adjoining cars.



The gasket at the left is for the 2-in. coupler and the one at the right is for use when coupling with the 1½-in. coupler

The Gold Car Heating & Lighting Company, 220 Thirty-sixth street, Brooklyn, N. Y., is now supplying 2-in. steam connections, including hose, couplers and end valves, which permit of unobstructed flow of steam from the locomotive to the rear end of the last car. The couplers which are constructed on the recommended contour lines will couple and lock with the present smaller couplers now in use. Therefore, the long passenger trains for which this equipment is intended can thus receive the benefit of the larger couplings at once before a complete



Method of locking the Gold 2-in. couplers

change has been made on the remaining cars, with the assurance that should any cars find their way into other trains not so equipped, they will be interchangeable.

The increased weight of the coupler over the Gold 1½ in. size is but 14 oz. These couplers can be used with flexible metallic joints. In the construction of the

coupler head, the lines of the Gold No. 804S coupler have been followed. The new head is of malleable iron substantially ribbed to withstand hard usage. The wedge-shaped lock provides ample take-up for wear.

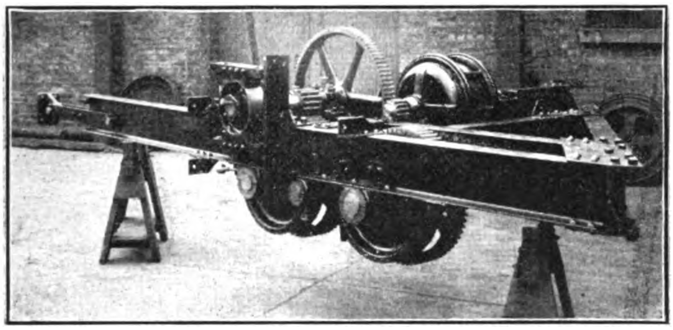
When in position for coupling the heads readily fit together and are steam tight. A tap from the inspector's hammer enters the wedge slightly over the accompanying toe to prevent lifting. It will be noticed that means are provided for the insertion of a link type lock, which can be supplied for locking with couplers of other types.

The gaskets used with the 2-in. couplers are of the oscillating type and are supplied in either Vulcabeston composition, or brass. They are furnished in two types, the standard 2-in. giving full opening, for use where all cars on any one train are equipped with the 2-in. connections. The second type, or the compromise gasket, provides a 1½-in. opening for use when coupled to the smaller couplers.

For the relief of condensation which lodges in the hose pockets between the cars, the No. 824S couplers are equipped with the Gold gravity traps. The internal pressure of steam in the coupler seats the valve and the trap is closed tight, there being no escape or leak, but the moment the pressure is relaxed, the valve, being heavier than the heads, falls away from the seat and all the water of condensation readily runs out, leaving the 2-in. supply line from the front to the rear of the train free for the passage of steam.

Two-wheel drive turntable tractor

GEO. P. NICHOLS & BROTHER, 2159 Fulton street, Chicago, has recently developed an improved type of turntable tractor which has two driving wheels and, therefore, is not effected by the tilting of the turntable to which it is attached. The connection to the end of the turntable is usually through a link. Turntable tractors with two driving wheels have been used for many years, but always with the disadvantage that the wheels and the tractor, was, therefore, forced by the motion of the table to travel in a circle with more or less side slipping and incidental wear and loss of power through friction.

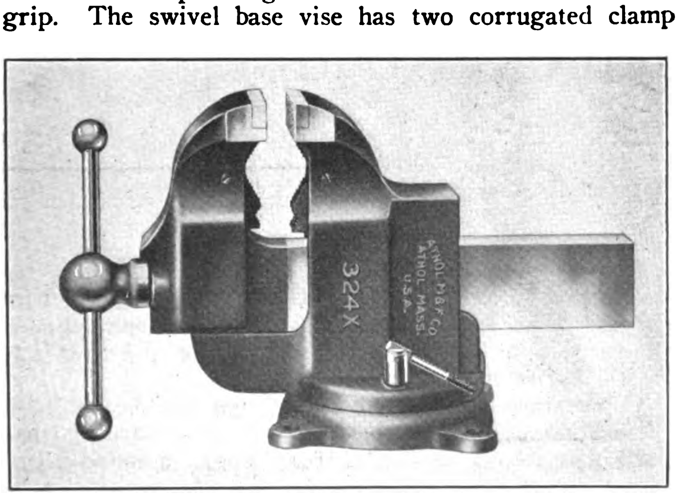


The Nichols two wheel drive turntable tractor with the operating cab removed

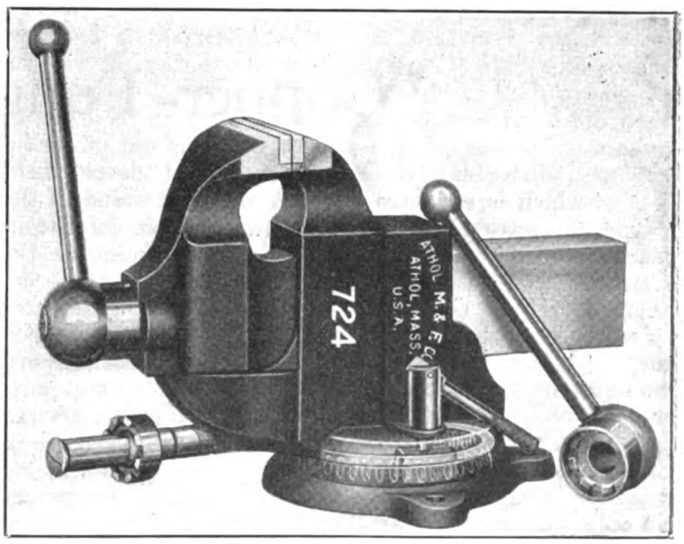
This tractor is designed and constructed with both of the driving wheels on radial axles that are radial and, therefore, the tendency is to run freely in a true circle without side slipping or loss of power. The drive from the motor to one of the traction wheels is identical with that on the Nichols single wheel tractor. The drive to the second wheel is through an equalizing pinion in the same plane with the two axles and with specially generated teeth, making it possible to use the standard driving gears on all installations, the pinion only being different. The tractor frame is made of 10-in. I-beams, the flanges being reinforced beneath all bearings so as to give no less than 1 in. of metal where the attaching bolts pass through.

Heavy machinists' and railway vises

THE vises shown in the illustrations, because of their weight and strength are known as heavy chipping vises. They are made of semi-steel castings, with tool steel jaw facings welded to the vise and hardened. These have deep corrugations on the faces to insure a firm grip. The swivel base vise has two corrugated clamp bolts, one on each side of the vise, which mesh with the corrugations in the circular runway of the swivel base, thereby locking the vise in any position desired. This fea-



The Athol combination pipe and machinists vise



A machinist vise provided with a swivel base

ture is of advantage when handling large pieces in the vise.

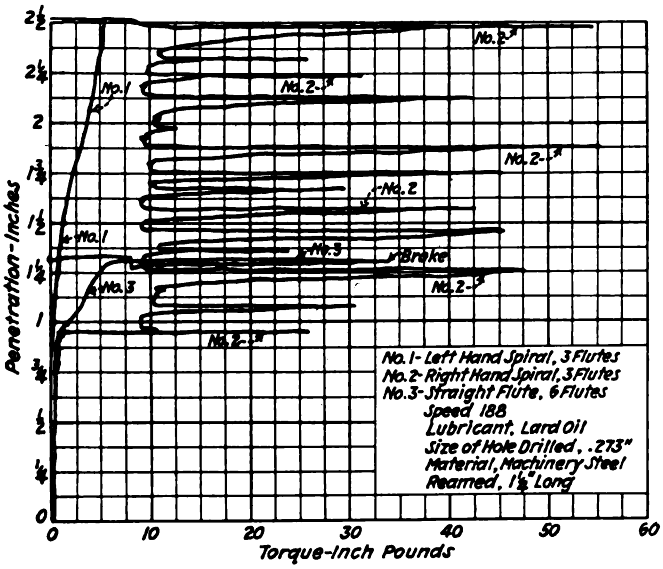
One of the illustrations shows a ratchet handle vise with a stationary jaw and swivel base which is suitable for the tool room. The ratchet handle is connected with the vise screw by a clutch in the handle and operates with a quick, positive action. After the vise is tightened the screw head is pulled out slightly, after which the handle may be placed where desired.

The other illustration shows a combination pipe vise, the jaws of which are made heavier than the regular vises in order to withstand the strain of the pipe work. The pipe grips are made of tool steel, machined from the solid bar and can easily be replaced when necessary. The pipe grips do not extend beyond the face of the vice jaws. This design increases the usefulness of the combination vise.

These vises are manufactured by the Athol Machine & Foundry Company, Athol, Mass.

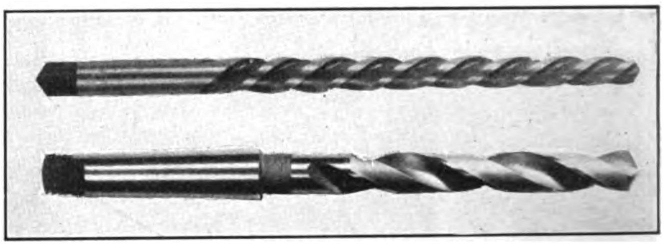
Drill and taper pin reamer—A correction

IN an article on page 386 of the June, 1926, *Railway Mechanical Engineer*, was given an account of tests of the three-flute taper pin reamer, of the Morse Twist Drill & Machine Company, New Bedford, Mass., comparing the performance of this reamer with reamers of the three-flute right-hand spiral type and the straight flute type.



Comparative torque test of the left hand spiral reamer, a right hand spiral reamer and a straight flute reamer

These tests were made on an Olsen autographic drill, tap and die testing machine in machinery steel in 1¼ in. long, feeding the reamer through a penetration of 2½ in., using the same time in each case. The article erroneously stated that the three-flute left-hand spiral reamer broke under a force of 5½ in.-lb., the straight flute reamer broke at 34 in.-lb., and the three-flute right-hand spiral reamer broke at 55 in.-lb. Reference to the graphic chart shows that only the straight flute reamer broke at a maximum torque of 34 in.-lb., while both the spiral reamers completed the operation intact. It will be seen, however, that the left-hand spiral flute reamer reached a maximum torque of 5½ in.-lb. and that this torque developed smoothly to a maximum at the maximum penetration of 2½ in., while the torque on the right-hand spiral reamer varied widely, reaching a maximum of 55 in.-lb. at approximately 1⅞ in. penetration and again just before the completion of the test. This chart clearly shows the free cutting action of the left-hand spiral reamer, which is shown at the top of the illustration herewith.



Bottom—Morse high speed forged type drill; Top—Taper pin reamer

Copper-Tungsten electrodes

COPPER-TUNGSTEN electrode, a development which is expected to prove of great value in the fabrication of metals, is now available for use in manufacturing. This announcement is made by the General Electric Company, Schenectady, N. Y., which developed the new electrode. One of the limiting features in many resistance or spot welding operations has been the copper electrode used, the pure copper not being hard enough when used under the high pressures at high currents common to this type of welding. Usually, after a few welds are made, the surface of the copper electrode in contact with the weld becomes hot enough to anneal the copper, thus making it very soft. As a result, the copper tip rolls and mushrooms over the edges, giving a large spot weld which changes the current density and, consequently, the quality of the work be electrically welded.

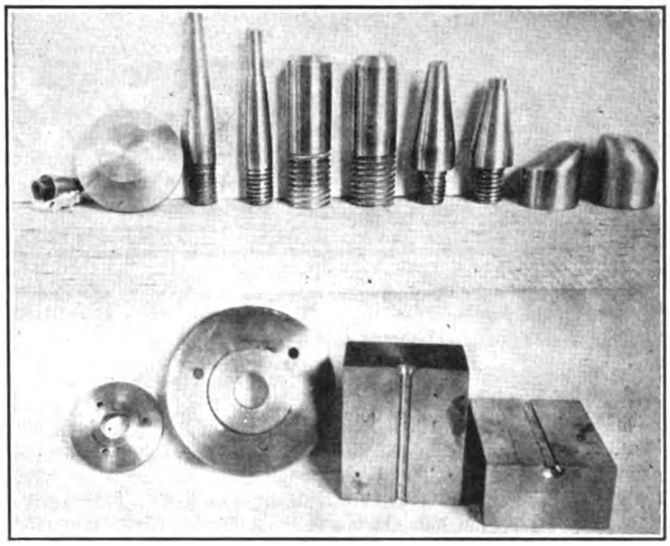
Copper-tungsten, as its name indicates, is a mixture of two metals—one a good electrical conductor and the other very hard. The alloy has a hardness of 225, Brinnell, as compared with 82 for hard copper and 30 for soft copper. The compressive strength of the copper-tungsten is 208,000 lb. per sq. in. as against 58,000 lb. per sq. in. for hard copper. The tensile strength is 56,350 lb. per sq. in., compared with 30,000 lb. for soft copper and 50,000 to 70,000 lb. for hard drawn copper.

Copper-tungsten does not anneal at red heat. Thus there is no soft surface metal to roll or mushroom when used in resistance welding. It has not been found necessary to form the entire electrode point or die of copper-tungsten, but rather to use inserts of this alloy by any one

of a number of methods, such as forcing an oversized piece in a hole in the die, brazing a block in the wearing surface or placing pieces in a mold and casting the die around them. The remainder of the die is made of copper as before.

In view of the higher first cost of copper-tungsten, its chief value is expected to be in special applications. It is particularly adapted for use under severe conditions where copper will not stand up. The durability of the new alloy is shown by a recent test, where the number of welds made with one dressing of a copper die averaged ten, while the first test using copper-tungsten inserts gave more than 1,000 welds with the die still in good condition at the end of the test. Other tests showed better results. It is therefore expected that the cost of changing the old copper electrodes and redressing them will more than pay for the larger first expenditure for copper-tungsten.

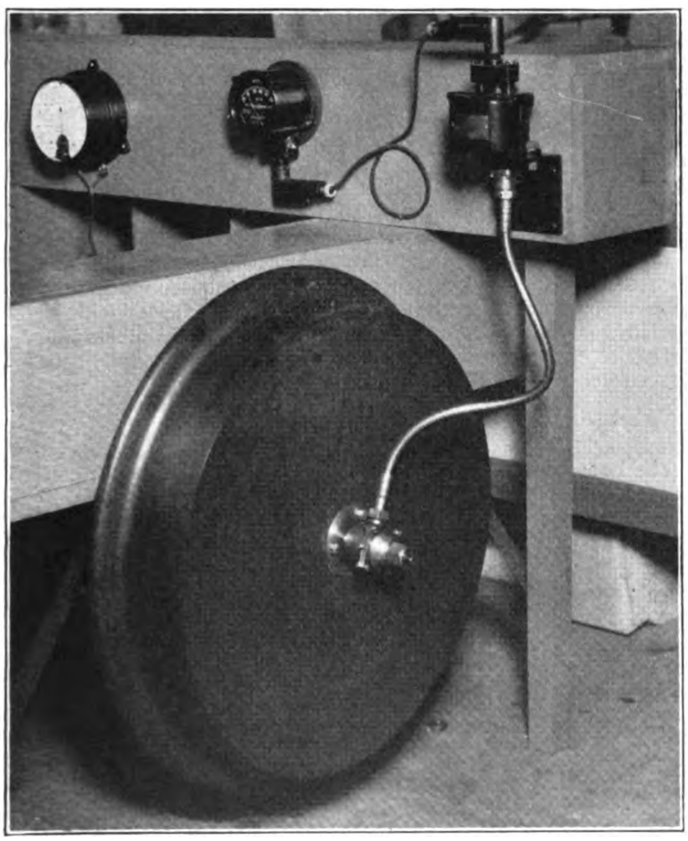
The material has been given the trade name Elkonite and will be manufactured and sold exclusively by the Elkon Works, Inc., Weehawken, N. J., of P. R. Mallory & Company.



Copper Tungsten electrode for electric welding

New magneto drive for locomotive tachometer

A NEW form of magneto drive has recently been developed by the Electric Tachometer Company, Philadelphia, Pa., in conjunction with the Westinghouse Electric and Manufacturing Company, Wilmerding, Pa., for the application of electric speed indicators to locomotives. This new drive permits the installation of an electric tachometer outfit in a few minutes, and eliminates the use of special gears, pulleys or belts.



Simplicity and ease of installation are claimed for this magneto drive

The outstanding feature of the new design is the method of driving the magneto from the locomotive wheel and the fact that this speed indicator operates independent of all other apparatus whereas previous designs were essentially attachments for use with train control. It has formerly been necessary to use special gears or a belt for this type of drive. The new drive eliminates the use of special attachments and also eliminates the possibility of lost motion in a slipping belt. It can be attached to any locomotive by the use of ordinary hand tools. The outfit is complete in itself.

The magneto is mounted with the shaft vertical on the framework above or adjacent to one of the leading wheels on the locomotive. A small gear box is attached to the end of the locomotive axle, outside of the wheel. Only three small tapped holes in the axle are necessary for mounting. A short length of flexible shaft connects the gear box to the magneto. The gear box contains a pair of bevel gears. One of these is attached to the locomotive axle and the other is mounted in a housing which is free to revolve around the first bevel gear as a center. The flexible shaft is attached to the second bevel gear and prevents actual rotation of the housing, although a small amount of motion is permissible. In action, the housing remains stationary and the gears revolve, transmitting motion through an angle of 90 deg. to the flexible shaft and magneto. This construction reduces the transmission problem to its simplest form and takes care of all movements of the locootive wheels with respect to the locomotive frame. It allows the magneto to be rigidly mounted, as its heavy construction requires, and at the same time provides a positive drive which is independent of various wheel positions.

THE ILLINOIS CENTRAL has ordered 50 2-8-4 type locomotives from the Lima Locomotive Works. These are duplicates of the Lima A-1 locomotive and will have 28 in. by 30 in. cylinders, 63 in. diameter driving wheels, 240 lb. boiler pressure. They will have a booster-equipped four-wheel articulated trailer truck, which makes possible one hundred square feet of grate area. The approximate total weight of one of these engines in working order will be 385,000 lb.

Missouri Pacific freight train makes 162-mile non-stop run

What is believed to be a world record for a non-stop trip by a heavy tonnage freight train was made by the Missouri Pacific on May 3, when Train No. 68 left Kansas City, Mo., at 5:20 p. m. with engine 1498, a stoker-fired coal-burning locomotive, in charge of Conductor J. W. Rutledge and Engineman W. W. Young, with Dispatcher J. T. Neal at the key. This train, with 57 loads, 2,455 tons, arrived at Jefferson City, Mo., 162 miles from Kansas City, at 11:15 p. m., making the run in 5 hr. 55 min. without making a stop in the entire distance. An auxiliary tank holding 10,000 gal. of water was provided to avoid the necessity of stopping for water, while the one tank of coal taken at Kansas City was sufficient to take the train through. Similar tanks are being used on other freight trains in this district to avoid the necessity of stopping for water.

Equipment installed

Class I railroads in April placed in service 10,617 freight cars, according to reports filed with the Car Service Division of the American Railway Association. This brought the total number of cars placed in service this year to 31,980, as compared with 57,926 during the corresponding period last year and 46,421 during the same period in 1924. Of the cars now reported 5,791 were box cars, 3,541 coal and 855 refrigerator.

Freight cars on order on May 1 totaled 48,762, compared with 43,301 on the same date last year and 68,019 on the same date in 1924. These included 21,259 box, 19,987 coal and 5,230 refrigerator cars. Class I railroads during April also installed in service 189 locomotives, which brought the total number placed in service up to 759. During the first four months last year 601 locomotives were installed in service and during the same period in 1924 there were 758. Locomotives on order on May 1 this year amounted to 654 compared with 340 on the same date last year and 552 on the same date two years ago.

These figures as to freight cars and locomotives include new and leased equipment.

Safety program for July

L. G. Bentley, chairman of the committee on education of the Safety Section of the American Railway Association, in circular No. 127, has issued the program to be followed during the month of July in the general campaign to reduce by 35 per cent, before the year 1931, the total number of casualties to railroad employees, as compared with 1924. His text is taken from the first paragraph of the "general notice" of the standard code of train rules: "SAFETY IS OF THE FIRST IMPORTANCE IN THE DISCHARGE OF DUTY"; a reminder that this subject was prominent in railroad life long before the beginning of the modern "safety-first" movement. Circular 127 deals with the necessity for rules; with the selection and training of new employees, and hints as to how to deal with violations of rules. The following points are set forth as the qualifications which should be sought in a workman when looking for candidates for a foremanship:

1—A conscientious desire for a safe administration.
2—Ability to win the regard and respect of subordinates.
3—Knowledge of the business to be supervised.
4—Ability to systematize.
5—Vision for development.

Switchers give thirty days continuous service

Four locomotives of the Terminal Railroad Association of St. Louis, during a recent test, were kept in continuous service for a period of 30 days without having any of the fires cleaned. These locomotives, equipped with Hulson grates, were assigned to heavy transfer service, being handled by regular crews on three shifts. At no time were the fires cleaned, their condition being kept good by shaking the grates regularly, at intervals depending upon the amount of fuel burned. Ash pans were dumped every eight hours, at the time of changing crews. At the end of the 30-day test period, the fires were in good condition and apparently could have been continued indefinitely but for the necessity of dumping to permit boiler washing. This test showed a large saving in fuel, as it is estimated that every time a fire is cleaned, about 500 lb. of coal is required to restore normalcy; formerly 16 hours was the average time between fire-cleaning periods. In a large system of busy terminals like St. Louis, having 200 switching locomotives, continuous service throughout the 24-hour period is essential, and there is no intermission in which repairs or service requirements may be performed as in road service.

Pennsylvania places orders for locomotives and dining cars at its Altoona works

The Pennsylvania Railroad, as part of its equipment program for 1926, has placed orders at its Altoona works for 60 six-wheel medium weight switching locomotives, known as class B6sb, for general service, and 24, 70-ft. all-steel dining cars of the latest type, class D78b.

These are in addition to orders recently placed with outside builders for 200 road locomotives for express passenger or fast freight service, and 234 all-steel passenger train cars of various classes.

The class B6sb locomotive has cylinders 22 in. diameter with 24 in. stroke. The driving wheels are 56 in. diameter. Including tender, the weight in working order is 305,300 lb.

The class D78b dining cars are of the same general plan as the ten diners which have just been completed. A number of different interior decorative designs and color schemes will be specially prepared for some of these cars, while in others the distinctive interior designs employed in the cars recently put into service will be repeated.

Consumption of babbitt metal

The Department of Commerce announces a total apparent consumption of babbitt metal, based on reports received from 27 firms, as 5,229,199 lb. in April, as compared with 5,860,543 lb. in March and 5,126,416 in April, 1925. This consumption is calculated from sales by manufacturers and consumption by those firms, among which are several important railroad systems, who consume their own production. In the following table the sales of babbitt metal are shown separately from the consumption in the producing plants:

1925	Total apparent consumption	Sales by manufacturers	Consumption by producers
January	5,683,183	4,620,815	1,062,368
February	5,164,619	4,103,340	1,061,279
March	5,644,288	4,395,901	1,248,387
April	5,126,416	3,928,136	1,198,280
May	5,081,668	4,189,558	892,110
June	5,074,966	4,085,125	989,841
July	5,184,196	3,694,386	1,489,810
August	5,441,823	4,068,706	1,373,117
September	4,621,033	3,579,780	1,041,253
October	5,550,247	4,169,870	1,380,377
November	4,954,683	3,534,026	1,420,657
December	4,878,806	3,910,160	968,646
Total	62,405,928	48,279,803	14,126,125
1926			
January	5,152,694	3,708,383	1,444,311
February	5,139,952	3,867,710	1,272,242
March	5,860,543	4,852,805	1,007,738
April	5,229,199	3,817,253	1,411,946
Total (4 mos.)	21,382,388	16,246,151	5,136,237

Meetings and Conventions

Twenty-fifth anniversary of Car Foremen's Association

The meeting of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, to be held at the Hotel Sherman, Chicago, September 21, 22 and 23, will be the twenty-fifth anniversary of the association, and plans are being made by the Executive Committee to make it the largest ever held. Many prominent speakers will be on the program, and a special souvenir booklet, giving a complete record of the association from its inception in 1901 to date, with a complete list of the membership, will be printed for the occasion.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention September 20-24, Municipal Pier, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. Building.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Convention September 21, 22 and 23. Hotel Sherman, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month. Terminal Hotel Bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

E. Theodore Sproull, assistant to the president of the Trumbull Steel Company, Warren, Ohio, has resigned.

The American Hoist & Derrick Company plans the construction of a one-story machine shop at St. Paul, Minn.

The Minwax Company, Inc., has removed its office from 10 East Huron street to 230 East Ohio street, Chicago.

H. C. McClary, vice-president of the Fairbanks Morse Company from 1907 to 1917, died at Evanston, Ill., on May 30.

Eagle-Picher Lead Company has moved its Chicago office from 208 South La Salle street to 134 North La Salle street.

Delbert C. Davis and Charles L. Kenyon have been appointed assistant treasurers of the General Electric Company, Schenectady, N. Y.

The American Steel Foundries, Chicago, has removed its St. Louis, Mo., office from 729 Frisco building to 1717 Railway Exchange building.

The Timken Roller Bearing Company will spend $1,500,000 to expand its Canton, Ohio, plant including enlarged laboratory and research facilities.

The Sullivan Machinery Company has moved its northwestern sales office from the Hutton building, Spokane, Wash., to 120 South Lincoln street.

The American Steel & Wire Company has opened a district office for Oklahoma and Kansas at 217 Atlas Life building, Tulsa, Okla., in charge of George F. Bell.

D. A. Corey, vice-president of S. F. Bowser & Co., Fort Wayne, Ind., has resigned. R. E. Lounsbury has been appointed industrial sales engineer, with headquarters at Albany, N. Y.

L. Gerald Firth has been appointed general manager, and R. S. Stevick works manager of the Firth-Sterling Steel Company, McKeesport, Pa. Mr. Firth was formerly works manager and Mr. Stevick his assistant.

The Chicago Steel Tank Company has leased 213,000 sq. ft. of ground with option to purchase at 6600 South Narragansett avenue, Chicago, on which it plans the erection of a plant which will be ready for occupancy in the fall.

Redmond F. Kernan has resigned as an officer and director of the Regan Safety Devices Company, Inc., New York, and Joseph Beaumont, vice-president and sales manager, has been elected director to fill the unexpired term.

W. H. Haile, district manager of the National Carbon Company, with headquarters at Pittsburgh, Pa., has been appointed manager of the railway sales division of the National Carbon Company, Inc., and the Prest-O-Lite Company, Inc., with headquarters at Cleveland, Ohio.

L. G. Plant has been appointed sales agent for special applications of coal, ash and sand handling equipment of the Ogle Construction Company, Chicago, Ill. Mr. Plant will continue also to represent the Locomotive Terminal Improvement Company as general sales agent for the direct-steaming system.

The Union Asbestos & Rubber Company has completed a new plant at Cicero, Ill., to manufacture a large variety of asbestos products bearing the Unarco trade mark. The plant covers a ground area of 175,000 sq. ft., with a factory floor space of over 100,000 sq. ft., exclusive of 20,000 sq. ft. of warehouse space.

Francis T. West, who has been the western manager of the Watson-Stillman Company, with headquarters in Chicago, for the past 25 years, has retired and has been succeeded by J. F. Coyne, with offices at 549 West Washington boulevard, Chicago, Ill. Associated with Mr. Coyne in the handling of the hydraulic machinery and accessory lines of the Watson-Stillman Company are James T. Lee and John O. Clark.

Lawrence A. Luther, for seven years with the Delaware, Lackawanna & Western, has joined the Ingersoll-Rand organization, having reported to the Chicago office on May 10. He will look after the servicing of Ingersoll-Rand pneumatic tie tamper equipment in use by the railroads of the middle-western territory.

Charles Leslie Rise, assistant works manager at the Hawthorne Works of the Western Electric Company, has been appointed works manager of the Hawthorne works, Chicago, in charge of all its manufacturing functions there. S. S. Holmes is now assistant works manager. Mr. Rice succeeds to the position formerly held by G. C. Stoll.

H. Allen Faust, Philadelphia, Pa., who has been covering the state of Pennsylvania, including the Philadelphia district and southern New Jersey, as salesman of brass pipe and tubular plumbing goods for the Bridgeport Brass Company, Bridgeport, Conn., has had his territory increased by the addition of Maryland, West Virginia and Washington, D. C.

Thomas O'Malley, president of the O'Malley-Beare Valve Company, Chicago, whose sudden death from heart failure occurred on May 14, was born in Jackson, Tenn., on October 12, 1875. He entered railway service as a call boy for the Illinois Central at Jackson, Tenn., in 1885, and in 1887, at the age of 12, he was appointed an operator, which position he held until 1903 when he was appointed dispatcher at Fulton, Ky. He held the latter position until 1909 when he was promoted to trainmaster of the Birmingham district of the Illinois Central, with headquarters at Jackson, Tenn., which position he held until 1910 when he resigned to become vice-president of the O'Malley-Beare Valve Company which he and his brother, Edward O'Malley, organized. He held the position of vice-president until March 17, 1926, when he was elected president.

Thomas O'Malley

The Cecil R. Lambert Company, Inc., Detroit, Mich., specialists in the design, manufacture and installation of conveying and handling equipment, in order to identify its products and service with its name, has changed the latter to Mechanical Handling Systems, Inc. The company's facilities for service are being materially increased by additions to its plant and personnel, but there is no change in ownership, management or executive staff.

The draft gear activities of the Westinghouse Air Brake Company have been taken over by the Westinghouse Friction Draft Gear Company, with sales headquarters at Room 913, Peoples Gas building, Chicago. H. B. Gardner, formerly a representative of the Westinghouse Air Brake Company, with headquarters at New York, has been appointed general sales manager of the Westinghouse Friction Draft Gear Company, with headquarters at Chicago.

Francis Hodgkinson, for many years chief engineer of the South Philadelphia Works, Westinghouse Electric & Manufacturing Company, has been appointed consulting mechanical engineer for the organization as a whole. The position of chief engineer of the South Philadelphia Works has been discontinued. A. D. Hunt has been appointed manager of engineering, a newly created position. He has for many years been a member of the engineering staffs of the Westinghouse organization, headquarters of which is located at Wilmerding, Pa.

The Jos. W. Hays Corporation, Michigan City, Ind., manufacturers of draft gages, flue gas analyzers, CO_2 recorders, and other combustion instructions, has changed its name to the Hays Corporation. Jos. W. Hays, who founded the business in 1907, has disposed of his entire holdings in the company in order to devote all of his time to his practice as a consulting engineer. Philip T. Sprague, the new president, was for a number of years vice-president and general manager of the Jos. W. Hays Corporation.

The Graybar Electric Company has signed a contract leasing the entire fifteenth floor of the proposed large office building to be located adjacent to the Grand Central Terminal, facing Lexington avenue and situated between Forty-third and Forty-fourth streets, New York. The new structure is known as the Graybar building, taking its name from the Graybar Electric Company. The building occupies over an acre and a half of ground. The Buffalo, N. Y., branch office of this company has been moved from 709 Main street to 77-79 Swan street.

G. W. Curtis, industrial equipment engineer of the Timken Roller Bearing Service & Sales Company, has been promoted to district manager of sales, Industrial division, with headquarters at Milwaukee, Wis., and will be succeeded by S. M. Weckstein. G. W. Richards and A. R. Spicacci have been appointed assistant industrial equipment engineers. H. E. Gilmore, representative of the Timken Roller Bearing Service & Sales Company, with headquarters in Chicago, has been appointed manager of the St. Louis branch. The Omaha branch office of this company has been moved from 2524 Farnum street to 2240 Douglas street. The Los Angeles branch has been moved from 1241 South Hope street to 1361 South Figueroa street.

Richard R. Harris has been appointed general manager of sales of the Pittsburgh Steel Company, Pittsburgh, Pa., and subsidiary companies which include the Pittsburgh Steel Products Company and the National Steel Fabric Company. Mr. Harris has been general manager of sales of the Pittsburgh Steel Products Company for about twenty years. George W. Jones, who has been assistant general manager of sales of the Pittsburgh Steel Company, has been appointed manager of sales, succeeding John F. Hazen, resigned. Charles F. Palmer, who has been manager of the Chicago office of the Pittsburgh Steel Products Company, has been appointed manager of sales of this company, and Edward L. Benedict continues as vice-president and manager of the sales department of the National Steel Fabric Company.

Lawrence K. Diffenderfer has resigned as secretary and treasurer of the Vanadium Corporation of America. Mr. Diffenderfer has left the Vanadium Corporation of America to engage in special accounting, tax work, industrial plant and mine valuation, and work of that nature. He has been succeeded by Edgar R. Alpaugh. P. J. Gibbons, chief clerk of the Bridgeville plant of the Vanadian Corporation of America, has been elected assistant treasurer. J. A. Miller, Jr., general sales engineer, has become assistant general manager of sales, with headquarters in New York. H. T. Chandler, assistant to the president, formerly located in Detroit, has been transferred to the New York office, in the same capacity. C. N. Dawe, formerly with the Studebaker Corporation of America, at Detroit, has become manager of the automotive division, with headquarters in Detroit, and T. N. Bourke, district sales manager, has become assistant manager of the automotive division, with headquarters in Detroit.

The Baldwin Locomotive Works has acquired a majority interest in the Midvale Company. The purchase was on a cash basis and no financing will be required. The Midvale Company owns the Nicetown plant, in Philadelphia, Pa., which was not included in the sale several years ago, of the Midvale Steel & Ordnance Company to the Bethlehem Steel Corporation. The Nicetown plant manufactures structural steel, ordnance, locomotive forgings, steel tired wheels and other iron and steel products. The Midvale Company's business will be continued as usual and it will increase its line of products so as to fit in with the Baldwin organization. There will be no change in the management of the Midvale Company. Samuel M. Vauclain will continue as chairman of the board and Alva C. Dinkey as president. Acquisition of the company will involve no change in the Standard Wheel Works at Burnham, Pa., or in the development of the Baldwin plant at Eddystone. The Midvale Company owns the entire capital stock of the Midvale-Philadelphia Company, operating warehouses in Cleveland, Chicago, San Francisco and Philadelphia.

Trade Publications

HAND OVERHEAD CRANES.—Book No. 104, giving the dimensions of a few standard types of Morris hand overhead cranes and showing their use in various industries, has been issued by Herbert Morris, Inc., Buffalo, N. Y.

ANTI-SLIP TREADS.—A leaflet descriptive of Feralun anti-slip treads and showing their structural application to several types of coach steps has been issued by the American Abrasive Metals Company, 50 Church street, New York.

PNEUMATIC RIVETERS.—The Hanna Engineering Works, 1765 Elston avenue, Chicago, has issued a bulletin descriptive of its pneumatic riveters and featuring the dependability of riveted steel for locomotives and cars, bridges, etc.

MODULATING VALVE.—A four-page illustrated folder descriptive of the Jenkins modulating radiator valve for one or two-pipe low pressure steam, vacuum and vapor heating has been issued by Jenkins Bros., 80 White street, New York.

NICKEL CAST IRON.—Bulletins Nos. 201 and 202 describing the properties and applications of nickel and nickel-chromium cast iron and the improving of gray cast iron with nickel, respectively, have been issued by the International Nickel Company, 67 Wall street, New York.

AIR COMPRESSORS.—The Sullivan belt-driven, wafer valve air compressors, Class WG-6, single-stage, and Class WH-6, two-stage, are illustrated and described in the second edition of Bulletin No. 83-B which has been issued by the Sullivan Machinery Company, 122 South Michigan avenue, Chicago.

TURRET LATHES.—Two booklets descriptive of the new Gisholt full swing side carriage turret lathes have been issued by the Gisholt Machine Company, Madison, Wis. One booklet describes the 3L and 4L lathe having a fixed center turret; the other, the 3L and 4L machine having a cross feeding turret.

WELDING AND CUTTING EQUIPMENT.—A miniature catalogue, No. 172C, of Milburn welding and cutting apparatus has been issued by the Alexander Milburn Company, 1416 West Baltimore street, Baltimore, Md. The catalogue contains 32 illustrated pages and a list of a few representative users of the equipment.

ELECTRIC PORTABLE HOISTS.—The Sullivan Machinery Company, 122 South Michigan avenue, Chicago, has issued Bulletin No. 76-G descriptive of the HE and HE-2 single drum, and the HDE double drum electric portable hoists which are designed for use where electric wires are strung to the work to be done, or when air power is not available.

TRANSFORMERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a four page leaflet, L. 20288, descriptive of the application, construction and distinctive features of its new shovel type transformers which are designed with leak proof bushings and tanks. Several illustrations and a tabulation of outline dimensions are also given in this leaflet.

DIESEL ENGINES.—Three bulletins descriptive of Diesel engines have been issued by Fairbanks-Morse & Co., Chicago. Bulletin No. 1010 describes the economy of Diesel engine power; Bulletin No. 1020 gives a comparison of Diesel engine principles, and Bulletin No. 1031 describes the construction and operation of the Type Y, Style VA, oil engine. Each of the bulletins is attractively arranged and well illustrated.

VERTICAL TURRET LATHE.—Specifications for the 54-in. New Era type of vertical turret lathe, having one swivel turret head and one non-swiveling side turret head, are given in Circular VT—3-54 which has just been issued by the Bullard Machine Tool Company, Bridgeport, Conn. This circular announces several changes and improvements which affect also the complete line of vertical turret lathes manufactured by the Bullard Company.

M-R-C THRUST BEARINGS.—Dimensions, load ratings and price lists covering M-R-C thrust bearings are given in a 36-page catalogue which has been issued by the Marlin-Rockwell Corporation, Jamestown, N. Y. These bearings are made single-acting or double-acting to compensate for end thrust loads acting in either one or two directions. They are designed to support end thrust loads only; that is, loads acting parallel to the axis of rotation.

VALVES.—Valves suitable for almost any condition encountered in industries using water, air, steam, acids, oils, heavy liquids, oil residue, high hydraulic pressures, etc., are listed in catalogue No. 33 issued by the Homestead Valve Manufacturing Company, Homestead, Pa. A complete line of plug type valves is shown, also several new products including the full round opening valve, the protected seat globe valve, the protected seat hydraulic operating valve, and the Homestead lubricated type valve.

DIRECT-INJECTION OIL ENGINES.—"Direct injection oil engines for all purposes," is the title of a new publication just issued by the Ingersoll-Rand Company, 11 Broadway, New York. The cover, which is printed in colors, illustrates the major title by portraying the Ingersoll-Rand oil engines as applied to railway, marine, powerhouse, industrial and building applications. The text matter consists of technical data and details of "PO" oil engines of 55, 110 and 150 b. hp. sizes and is profusely illustrated by illustrations of plant layouts, installation views, diagrams and engine details.

SUPERHEATERS.—A brief story of 140 years' progress in the development of the locomotive superheater is contained in a 12-page booklet issued by the Superheater Company, 17 East Forty-second street, New York. The years reviewed in this story are 1786-1926, during the former year the first superheater patent having been granted to Joseph Hateley. A few facts about Elesco superheaters, feedwater heaters, exhaust steam injectors and the superheater unit reclaiming service offered by the Superheater Company are given in a 20-page brochure entitled "Elesco and the Railroads."

THREE-CYLINDER LOCOMOTIVES.—The American Locomotive Company, 30 Church street, New York, has issued Bulletin No. 2003 illustrating and giving the principal dimensions, weights and proportions of a number of Alco three cylinder locomotives, among which are the Union Pacific and the Overland types built for the Union Pacific, the Southern Pacific type built for the Southern Pacific, the Lehigh Valley type built for the Lehigh Valley, and the Mohawk type built for the New York Central Lines. The bulletin also contains the paper on the Alco three-cylinder locomotive by J. G. Blunt before the Chicago section of the American Society of Mechanical Engineers.

PNEUMATIC TOOLS.—Under the title of "Pneumatic Tool Pocket List for Railway Shops," the Ingersoll-Rand Company, 11 Broadway, New York, has recently issued a catalogue listing various pneumatic tools which it manufactures that are applicable to railway uses. The catalogue section includes the usual specification data, covering drills of various types and sizes, grinders, hammers, sand rammers, and motor hoists, as well as sketches and dimensions of a large number of rivet sets, chisels, etc. The book is more than a catalogue, however, in that it contains 145 illustrations from photographs showing the use of the various tools in actual operation on railroad jobs and thereby giving considerable information as to the sizes and types of tools preferable for many different classes of work. The book is substantially bound in a leather substitute.

LOCOMOTIVE FEEDWATER HEATER.—Graphical charts for the computation of heat recovery and exhaust steam condensed and returned to the boiler with open-type feedwater heater operation are contained in the attractive 28-page bulletin, No. BK-1607-D, which has just been issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. Following an outline of the advantages and economies to be gained through the use of the open-type heater, the construction, application and operation of the Type BL feedwater heater are described, the course of steam and water through the equipment being shown in a colored diagramatic view. Considerable space is devoted to locomotive photographs showing installations throughout the United States and Europe, and the technical side of feedwater heating is dealt with to some extent in the appendices in the second half of the book.

Personal Mention

General

C. M. KIRKBY, special representative to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, has resigned to become mechanical engineer of the Missouri-Kansas-Texas, with headquarters at Parsons, Kans.

G. A. MILLER, superintendent motive power and machinery of the Florida East Coast, with headquarters at St. Augustine, Fla., who recently made application for retirement, has been assigned to special duties relating to the completion of the Miller shops at St. Augustine, with the title of superintendent motive power and machinery, retired, pending formal retirement.

I. C. Blodgett

IRVING C. BLODGETT has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass. Mr. Blodgett was born on November 10, 1883, at Saratoga Springs, N. Y., and was educated in the Saratoga Springs High School. He entered railway service in May, 1901, as a fireman on the Boston & Maine, and in 1905 he was promoted to engineman. In 1916 Mr. Blodgett was appointed road foreman of engines, which position he was holding at the time of his recent appointment as assistant to the mechanical superintendent of the Boston & Maine.

FRANK S. ROBBINS, whose appointment as superintendent of motive power and machinery of the Florida East Coast, with headquarters at St. Augustine, Fla., was announced in the June *Railway Mechanical Engineer,* was educated in the public schools, the Newark Technical School (at night) and at Purdue University. Mr. Robbins entered the service of the Pennsylvania in 1900, and until 1907 was consecutively machinist apprentice and special apprentice at the Altoona shops. In 1907 he became inspector in the locomotive testing plant. During 1908 he was in the service of the Berwind White Coal Mining Company as Porto Rico Fuel Demonstrator, and then he returned to the Pennsylvania as assistant general foreman. In 1910 he became assistant road foreman of engines, and in 1912, assistant master mechanic. During the war he was for a time a captain in the engineers, was then with the Railway Transportation Corps, A. E. F., France, and later became superintendent of motive power of the 16th and 20th Grand divisions respectively, and in 1918 became a major in the engineers. He returned to the Pennsylvania again in 1919 as assistant engineer of equipment in the general office. Mr. Robbins then became master mechanic at the Pittsburgh Terminal. From 1921 to 1922 he was in China as mechanical advisor to the Inter-allied Technical Board of the Chinese Eastern Railway. In 1922 he entered the service of the Pittsburgh Testing Laboratory as railway representative and district manager of the Philadelphia office, which position he was holding at the time of his recent appointment as superintendent of motive power and machinery of the Florida East Coast.

Master Mechanics and Road Foremen

D. C. REID has been appointed master mechanic of the Indiana Harbor Belt, with headquarters at Chicago.

JOHN T. NEWKIRK, assistant road foreman of engines of the Baltimore division of the Pennsylvania, has been appointed road foreman of engines of the Delaware division.

ARTHUR L. FILLMORE has been appointed master mechanic of the Winnipeg Division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Thief River Falls, Minn.

C. H. WOMACK has been appointed road foreman of engines of the Ashland Division of the Chesapeake & Ohio, with headquarters at Ashland, Ky., succeeding G. H. Saunders, resigned.

J. G. PERRY has been appointed road foreman of engines of the Logan Coal Sub-divisions of the Chesapeake & Ohio, with headquarters at Peach Creek, W. Va., succeeding C. H. Womack.

WILLIAM F. BUSCHER has been appointed general master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Shoreham, Minn., succeeding Louis Ernest, deceased.

CHARLES A. BAUERS has been appointed master mechanic of the Gladstone Division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Gladstone, Mich., succeeding A. C. Peterson.

F. W. GRATIOT, road foreman of engines of the Eastern division of the Missouri Pacific, with headquarters at Jefferson City, Mo., has been transferred to the White River division, with headquarters at Aurora, Mo.

Car Department

W. J. HARRIS has been promoted to car foreman of the Canadian Pacific, with headquarters at Farnham, Que.

C. A. MURDOCK has been promoted to car foreman of the Canadian Pacific, with headquarters at Newport, Que.

WILLIAM M. NELSON has been promoted to supervisor of air brakes of the Buffalo, Rochester & Pittsburgh, with headquarters at DuBois, Pa., succeeding Harry Sneck, deceased.

T. E. FORSTER, assistant car foreman of the Southern Pacific Lines at Yoakum, Tex., has been appointed freight car foreman of the International Great Northern, with headquarters at Palestine, Tex.

H. E. REUSCH has been appointed division car foreman of the Central of New Jersey, with headquarters at Ashley, Pa. Mr. Reusch's jurisdiction extends over the L. & S. division, including Phillipsburg, N. J.

Purchases and Stores

F. V. JAMES has been appointed storekeeper of the Chesapeake & Ohio, with headquarters at Charlottesville, Va.

T. C. SYDNOR has been appointed storekeeper of the Chesapeake & Ohio, with headquarters at Ronceverte, W. Va.

R. E. MATHIS has been appointed general storekeeper of the Missouri & North Arkansas to succeed L. Frost, who has resigned.

T. J. FRIER has been appointed purchasing agent of the Ann Arbor and Manistique & Lake Superior, with headquarters at St. Louis, Mo.

K. P. CHINN has been appointed assistant general storekeeper of the Southern Pacific Lines in Texas and Louisiana, with headquarters at Houston, Tex.

A. C. SIMMONS, who has been acting purchasing agent of the Chicago Great Western, with headquarters at Chicago, has been appointed purchasing agent.

Obituary

LOUIS ERNEST, general master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, died in Minneapolis, Minn., on May 24, after a short illness.

HARRY SNECK, supervisor of air brakes of the Buffalo, Rochester & Pittsburgh, with headquarters at DuBois, Pa., died on May 16, after a brief illness.

Railway Mechanical Engineer

Vol. 100 August, 1926 No. 8

Opposite views on engine stripping

There are at least two clearly defined and opposite views regarding the extent to which locomotives should be stripped or dismantled when received at the back shop for heavy repairs. Briefly stated, one of these is that a locomotive, having made the full required mileage between general shoppings, deserves complete inspection and overhauling in every detail in order to assure a minimum of expense and delay for running repairs at enginehouses during the next period of road service. One railroad which adheres to this idea and has an enviable reputation for the condition of its power, presses out every crank pin on a general repair locomotive, turns and rolls it (if within the shop limits of size) and presses it back in the wheel center. Every main driving journal is turned and rolled irrespective of whether it is worn tapered or straight, rough or smooth.

Those who take the opposite position advocate as little stripping as may be necessary to get at parts which are worn and need repairs, and as little machine work on the parts so removed as is essential to good practice. They do not advocate slip-shod methods or poor workmanship, but they do say that certain parts of a locomotive need not be removed in order to give the locomotive a thorough overhauling and that all of this work of stripping, machining and replacing which is saved, represents so much clear gain and has a very desirable effect in reducing shop costs. Proponents of this idea have in one case gone so far as to require the erecting gang foreman or his head machinist to supervise the stripping to make sure that no parts shall be removed which are in sufficiently good condition to be within the established limits of wear permissible on locomotives going out of the shop.

The extent to which locomotives should be stripped for general repairs in the back shop certainly is a vital subject, about which it is possible for fair-minded men to disagree. No one will attempt to justify inferior workmanship but there is a difference of opinion regarding the advisability of stripping the locomotives to the ground for general repairs or leaving in place certain parts which appear to have little or no wear. The chances are that one of these practices has more merit than the other, and it is highly important that the railroads as a whole follow the better practice of the two because large expenditures for maintenance are involved.

The *Railway Mechanical Engineer* would like to bring out the ideas of its readers on this subject and thus assist in arriving at an intelligent basis for a solution of the problem. Mr. Shop Officer, if you are following one of these plans or the other, write and tell us why. Describe your practice in simple, straightforward language, explaining its advantages and the results secured. Mr. Master Mechanic and Mr. Roundhouse Foreman, tell us how locomotives repaired by these two methods are performing on the road. Your letter or article need not be long and don't worry if a few punctuation marks are missing. Anyone can supply them. What the world needs is ideas. Let the railroads have yours.

Fuel economy at engine terminals

C. J. Beshears, writing in the July Frisco Employees' Magazine, calls attention to the fact that the cost of terminal fuel forms an important part of the railroads' coal bill and points out in a striking way the important economies which can be effected by banking locomotive fires properly at terminals. A few months ago Locomotive 326, a small 2-6-0 engine belonging to the St. Louis-San Francisco, was reported held under fire for 78 hours at Fort Scott, Kan., on 26 scoops of coal or approximately 390 lb., and the same coal was used in spreading the fire and making the engine ready for service. Another test made subsequently with a locomotive having 50 sq. ft. of grate area demonstrated the possibility of holding a fire 11 to 12 hours on 25 to 30 scoops of coal, or approximately 450 lb. In view of the size of the railroad coal bill, every effort should be made to minimize coal consumption in the various branches of service. Isolated power plants at small shops and engine terminals offer a fine opportunity for coal saving in many instances and this question of saving by proper banking of locomotive fires is only one example of what can be done.

The initial step in saving locomotive fuel at engine terminals is to see that locomotives come to the terminals with light fires in as good condition for cleaning as possible considering the kind of coal used. Otherwise good fuel must be wasted in the cleaning operation. A few shovels of coal can be spread evenly over the firebox in case additional steam is required for testing appliances but this testing should be done at once and as nearly as practicable at one time so that it will not be necessary to disturb the bank later. The main idea is to use the steam pressure on the locomotive in storing water in the boiler after the fire is cleaned and then bank the fire in such a way as to prevent the coal from burning out and permit its subsequent use in raising steam pressure. If 80 or 100 lb. of steam must be kept on the locomotive for occasional movements, coal has to be applied nearly every hour and the injector worked, which wastes fuel. Some railroads have found smokstack covers a great aid in preventing the creation of draft and consequent combustion of fuel.

Firing up engines is also a considerable item of terminal fuel expense and in another test on the Frisco at Chaffee, Mo., as reported in the article mentioned, it was demonstrated that a 1300 class locomotive with 50 sq. ft. of grate area can be fired up with 45 scoops of

Illinois run of mine coal, one 15-lb. scoop of coal per square foot of grate area being found to give a fuel bed four inches in depth.

More knowledge is required of master blacksmiths

New developments in machine tools and shop equipment have had a revolutionary effect on the work of practically all crafts employed in railroad shop work. These developments have, as a rule, tended to eliminate the need for skilled craftsmen to such an extent that a great many jobs formerly the handiwork of a trained mechanic are now performed by a machine which is operated by a man having only a few months' experience. Undoubtedly, the blacksmiths more than any other craft, have been required to change their methods and practices due to new developments in their work. Developments in forging machinery, welding and heat treatment have not only caused reductions in blacksmith shop forces, but these developments have achieved increased production with better uniformity in quality and workmanship. Any one familiar with the work done in a railroad blacksmith shop knows the amount and variety of work that can be turned out on a modern bulldozer or forging machine as compared to the old method of hand forge and anvil. These developments have tended to make blacksmith shop foremen close students of production methods and this tendency is perhaps indicated by the large number of dies, jigs and fixtures designed to facilitate production which were shown at the 1925 convention of the International Railroad Master Blacksmiths' Association. But quantity production is worthless without quality and the latter is only obtained by knowledge of *how* the work should be done.

Knowledge of production methods is not all that is required of the present day railroad blacksmith shop foreman. The past ten years has been a period of remarkable progress in the arts and sciences directly related to the blacksmiths' craft. Chemistry, metallurgy and mechanical and electrical engineering have all contributed something to its development. Few master blacksmiths have the time or the opportunity to study to become experts in the theory of the various welding processes and the heat treatment of steel, but they must be experts in their practical application.

The ability to make practical applications, however, does require some knowledge of the theory of the various processes mentioned. This knowledge can only be obtained from those who have made a special study of the subject and who have become experts in their respective professions. It is unfortunate that the Blacksmiths' Association has not seen fit to invite experts in the various technical professions related to the craft to present papers at its conventions. Quite a number of railroad associations have taken cognizance of the fact that they must go to all sources of information in order to obtain complete knowledge and facts pertaining to their field. The experience of these associations has shown that such a policy has been beneficial to the members and has also made the printed proceedings a valuable reference book, as information from all sources is contained therein. It is to be noted that papers presented by experts employed by railway supply manufacturers are prepared on an engineering and not on a propaganda basis, and are invaluable contributions to the influence of the associations.

It is essential that the master blacksmiths-work in close co-operation with the technical professions with the object of keeping in touch with developments that have practical shop applications. The International Railroad Master Blacksmiths' Association has already done considerable work along this line but there is still much to be done towards clearing up misunderstandings on the part of both the craft and the supply manufacturers. In this the association should request the support of both the railroad and railway supply industries.

Accurate data for locomotive improvements

Before any successful locomotive can be built, the designer must have complete knowledge of the conditions under which it is to be operated—weight of rail, layout of road as to grade and curvature, weight and character of trains to be hauled and running speeds. Without this knowledge there would be no way to insure the ability to meet traffic conditions. All these factors, however, can be determined in advance with comparative ease. Success of the design depends also upon reliability of performance in service, freedom from breakdowns and the need of either frequent adjustments or minor repairs. These demands can be met by a knowledge of materials, calculations of stresses, with a sufficient allowance for the unknown, and a knowledge of the performance of detail parts on similar locomotives.

Engine failures and maintenance costs are watched sharply by other departments as well as by the mechanical department. Then, the engineman and fireman must be thought of and due consideration given to the cab layout and the selection and location of fixtures and piping for convenience of access. This may seem to be of somewhat minor importance and, while the examination of locomotive cabs frequently leads one to the conclusion that a little more time and study might well have been given by the designer to the details of cab design, much more thought is being given to these points than was formerly the case. Here, again, knowledge which can best be gained by riding engines is most valuable to the designer. Mention might be made of many other details of construction where data, both theoretical and that gained from practical experience, is essential to the working out of a complete and successful design.

The places where present interest is the greatest and where there is the largest field for further development are found in these parts of the boiler and engine which have to do with overall thermal efficiency. A successful design of a locomotive, as the term is beginning to be generally accepted today, implies the production of a transportation machine that is economical in its fuel and water consumption as well as one that can be depended upon to get the trains over the road on time and can also be maintained without too much attention or too great expenditures for labor and material.

Unfortunately, the data on which the designer has to rely in order to obtain the maximum drawbar horsepower per pound of fuel are by no means as well known or as accurate as are the data available for other points of design. For the securing of greatly needed data it is essential that many locomotive tests be carefully conducted—tests with a dynamometer car in actual train handling on the road and then tests on a fixed testing plant. The changes in boilers, with modifications in design, proportions and steam pressures, together with the modifications in cylinder arrangement, valve gears and the re-introduction of compounding all make the need of proper tests of far greater importance than heretofore. The conducting of such tests might well be a function of the Mechanical Division of the A. R. A., as all roads would benefit by the data obtained. This is, moreover, but following a precedent

established in the undertaking of power brakes, truck frames and draft gear tests. However, without waiting for such action, a number of the more important railroads which do not now possess dynamometer cars, would find that the money spent for their purchase would yield big returns and aid them in securing much more efficient motive power.

Mechanical department employees and the public

A railroad or other public utility must cultivate the public which it serves. American railways know only too well what the displeasure of the public means—indeed we may go much further and say that severe and unnecessary restrictions and handicaps have frequently been placed upon the railways by representatives of the public because the citizens in general have not been fully or correctly informed as to the facts about the railroads and the extent to which the interests of the public and the railroads are mutual. Much, however, has been done in recent years to educate the public in these respects, so much so that there has been a radical change in the attitude of the public towards the railroads.

One important factor affecting the relations between the railways and the public must ever be kept in mind. The public judges a railroad not only by the character of the service rendered, but by its employees—their personalities and actions and their attitude toward both the public and their employers. While few of the mechanical department employees come in direct contact with the public in the performance of their duties, nevertheless they are regarded as representatives of the railroad, and a part of it, in the eyes of their neighbors and fellow citizens. If an employee who depends on the railroad for his livelihood cannot talk intelligently about it and its needs to his friends, or if he is constantly criticizing the management and does not boost the road, or if he is an indifferent and unintelligent citizen, it is a reflection upon the road in the eyes of those with whom he comes in contact, whether he is on or off duty.

Because a railroad is a public service institution and because so much depends on its scope and efficient operation, the employees who are well paid in comparison with workers in other fields and industries should be above the average. Is it not obvious also that railway workers should not only be thoroughly trained and coached in the performance of their duties, but that they should be posted as to the facts about their railroad and its operation and the more simple and fundamental principles of the economics of transportation? Should they not also be encouraged to take a real interest in public questions and the welfare of the communities in which they live? Many of them now do this, but is it not true that far too large a proportion are more or less indifferent to these things?

There are, of course, many ways in which this problem can be approached, but only one avenue will be here considered—that of the selection and training of new employees, particularly the younger ones. It is significant that not a few railway officers are now giving special attention to the recruiting of their forces. No longer are they standing back waiting for the young men to approach them for jobs, but they are actively searching for the best boys who may be available in their districts in the near future. It can safely be said that the relations between railway officers and school superintendents and high school principals are far more intimate in general than they were a decade ago, or even five years ago. Then too it is quite surprising to see how many mechanical departments have faced seriously the importance of the right kind of apprentice training. The Santa Fe, which has so long led the procession—for a time it was mostly leader and little if any procession—will have to look to its laurels if it is to retain its leadership. It is significant also that so large a proportion of the apprentice supervisors and instructors are impressed with a responsibility of the moral and citizenship training of the apprentices. At the same time the government through its vocational training agencies is assisting in the technical training of the apprentices on some railroads, and is evidently prepared to render still wider service if called on to do so.

This is all well and good, but how about the army of clerks, messengers, etc., in the mechanical department? Is it not just as important that the training and development of these young men should be given some attention on the part of the management? Do these neglected groups not offer a real opportunity? What might it not mean if these young men were more carefully selected with a view to their future development and usefulness? What might it not mean to the railroad if greater thought and study were given to coaching and training them in order that they could render more intelligent and efficient service to the mutual advantage of themselves and the railroad? What might it not mean in the way of inspiration if they had a better understanding of the importance of the railroad from the economic, political and social viewpoint? It may be difficult to devise ways and means of remedying these shortcomings, but will not the effort or expense involved be well worth while?

New Books

Railway Track and Maintenance. *By E. E. Russell Tratman, associate editor, Engineering News-Record, 490 pages, 6 in. by 9 in. Bound in cloth. Published by McGraw-Hill Book Company,* 370 *Seventh avenue, New York. Price* $5.

Anyone who undertakes to write a book on a subject of as broad a scope as that implied by the title of this work is confronted with two alternatives—to prepare an exhaustive treatment covering certain restricted phases of the subject in minute detail or to cover the subject from all angles, including related matters which may be deemed to have some bearing on the main topic. In Railway Track and Maintenance the author has adopted the second of these two ideas to an extent which indicates that his primary appeal is to the student or to the young man entering the railway service who must gather as quickly as possible a general knowledge of railroading insofar as it relates to his duties in railway engineering or maintenance of way work. If this was the author's intention he has succeeded, for there is little which has to do with railway track and its maintenance which has not been touched upon in some form.

The book opens with an introductory chapter on the general nature of track and its maintenance, followed by chapters dealing with roadbed and ballast, ties, rail, fastenings, etc., and other physical features of the fixed property, including brief reference to water and coal facilities, cinder disposal, yards and terminals, passenger stations, etc. The second half of the book carries the sub-title "Maintenance Work and Economics" and deals with organization and methods covering not only track maintenance but also "bridge work and telegraph work," "signals," "improvements and betterments," "emergency work," "records, reports and accounts," etc. Frequent reference is made to the work of the American Railway Engineering Association and to the standards and practices of specific railroads.

Combustion efficiency in locomotive boilers

Losses in unburnt fuel, radiant and convection heat, and tube lengths important factors

By Louis A. Rehfuss

AT moderate speeds and at slow rates of firing, the modern steam locomotive is an efficient combustion machine. With the demand for more power within the limited dimensions available, however, a different story is told. It has become customary to design locomotives to deliver their rated tractive force when burning 120 lb. of coal per sq. ft. of grate per hour, a rate not approached in stationary practice.

What this forcing of the fires does to our combustion efficiency may be shown by the following table, approximated by the writer from published test results, giving the disposition of the coal actually fired:

Rate of firing, coal per sq. ft. of grate per hour	50 lb.	100 lb.	125 lb.	150 lb.
Utilized in evaporation, per cent	70.8	62.5	56.0	51.0
Loss in unburnt fuel, per cent	10.0	19.0	26.0	34.5
Outside losses (radiation), per cent	3.5	3.5	3.5	2.5
Carbon monoxide losses, per cent	0.7	1.0	1.1	1.0
Smokebox gases, per cent	15.0	14.0	12.4	11.0

With the losses in smokebox gases and by radiation, we are not primarily concerned, since these are not losses to be traced to inefficiency of combustion. On the other hand the losses in unburnt fuel are serious and it is with these that we would treat. It is evident that no power plant that allows 25 to 30 per cent of the fuel fed to it to pass out unconsumed can be called efficient.

The rules for complete combustion are well known and comparatively simple, although not always so easy to apply:

1—The fuel must be intimately mixed with the required amount of air.

2—The temperature necessary for complete combustion must be maintained a sufficiently long period of time to obtain the required chemical combinations.

3—The human element in firing must be carefully taught.

From the care practiced in taking test plant data, we can hardly lay the blame on the third element. The fault must lie in the design of the locomotive boiler itself, and in its inadaptability to the high rates of firing to which it is subjected.

These losses in unburnt fuel, aside from that left in the ashes, are comprised principally of sparks, cinders and small particles of carbon released by the breaking up of the coal from the heat of the fire. The powerful draft used at high rates of firing sweeps these out of the firebox so swiftly that they do not have time to burn, or even to mix intimately with the air supply. As soon as the gases strike the small bore fire tubes their temperature is quickly reduced to a point where the unconsumed carbon particles are free to pursue their course up the stack unburnt. The comparatively small combustion space of the customary locomotive facilitates this action. The intermittent and explosive action of the exhaust contributes to this end, since its pulsating character acts as a jerk on the fire. All of these influences make it difficult to obey the two primary laws of combustion.

The American railroad man recognizes these conditions, but in his desire for maximum power from given engine units he has been forced to compromise at the expense of fuel economy. Of late years the conservation of fuel has been given more attention and some solution must be found for this problem. Particularly is this so when the trend of the times clearly demands more and more power, enhancing that forcing of the fires which creates the condition at issue. For this reason a discussion that has been going on for some time in the engineering world on radiant heat is of timely interest.

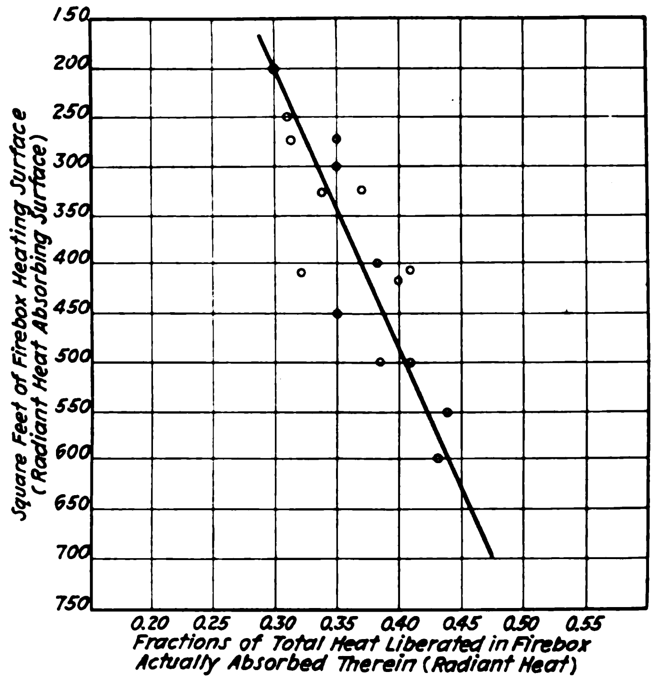


Fig. 1—Variation of radiant heat absorption in the firebox burning 6,000 lb. of coal per hour

Radiant heat defined

In the production of heat by combustion we release several kinds of heat. Radiant heat is the heat transmitted from one body to another separated from it without giving up any heat to the gases that may lie between. The heat we receive from the sun is of this nature. Convection heat, on the other hand, is transmitted by contact, as of one gas particle to another, or by gas particles striking tube walls.

The swifter the gases are swept along a given metal surface, such as a tube, the greater will be the convection heat absorption therefrom for a given tube surface area. The smaller the bore the swifter must be the flow to enable a given volume of gases to pass through. This is the explanation of the high evaporation rates possible on locomotive boilers at high rates of firing. Unfortu-

nately this does not help the combustion, as the gases are chilled too quickly to consume the unburnt fuel particles.

Radiant heat, on the other hand, does not depend for its absorption on speed of flow, but rather the reverse. In the locomotive boiler a large part of this radiant heat is absorbed by the firebox, but not all. It becomes important, then, to determine the percentage of radiant and convection heat on which we may rely.

The formula known as the Stefan-Boltzmann law is generally accepted by engineers, which shows that the radiation proceeding from a hot body is proportional to the fourth power of the difference of the absolute temperatures. Broido, Orrok and others have made this the basis of a simplified method of determining what fraction of the total heat liberated in the furnace will be absorbed by radiation. From data given in their recent papers (published in Mechanical Engineering, February and March 1926), and not confined to any one type of boiler, the writer has drawn Fig. 1, to show how the proportion of radiant heat absorption in the fire box varies with the amount of evaporative surface provided.

Thus, for 300 sq. ft. of surface, where coal is burned at the rate of 6,000 lb. per hour, this fraction will be about .35, while with 500 sq. ft. of firebox surface it would rise to .42. The ability to obtain this large percentage of the total liberated heat by absorption in the firebox without chilling the fire and reducing the efficiency of combustion itself, of course depends on an increase in the firebox volumes commensurate with the increase in firebox surface.

The balance of the heat, say 60 to 65 per cent, part of which finally is lost with the smokebox gases, enters the tubes. It has been the custom heretofore to regard all heat absorbed by the firebox as radiant heat received directly from the fire, while the heat left in the gases as they entered the tubes was considered only convection heat, so that it was considered correct to speed the gases at once down small bore tubes. This is not the case. Not only does the firebox heat absorption contain some convection heat absorption, but the gases themselves radiate heat in the tubes to a degree hitherto little suspected.

It was long known that for every drop of one degree in temperature of the gases at high temperatures much more heat was transmitted than for an equal drop of one degree at lower temperatures, but the explanation was not forthcoming. It is now shown that the gases themselves, or rather the carbon dioxide and hydrogen elements thereof, emit considerable radiant heat at high temperatures, and therefore must be regarded as following the Stefan-Boltzmann law much as does the radiant heat from the solid fuel particles of the fire in the furnace itself. This means that the hot gases as they enter the tubes possess a very high degree of radiant heat, which decreases rapidly as the gases cool down. Thus, in an example given by Broido (Mechanical Engineering, February, 1926), of a stationary water tube boiler, the gases in their passage over the tubes transmitted the following percentages of radiant and convection heat:

	Radiant heat	Convection heat
At 800 deg. gas temp	14.8 per cent	85.3 per cent
At 1,600 deg. gas temp	23.7 per cent	76.3 per cent

By applying the Stefan-Boltzmann law to the same data for greater temperature ranges under the same conditions, the writer derives the following ratios of heat transmitted:

	Radiant heat	Convection heat
At 2,000 deg. gas temp	37.2 per cent	62.3 per cent
At 600 deg. gas temp	12.0 per cent	88.0 per cent

Broido draws the conclusion rightfully from these facts that, as the heat transmitted by convection varies with the speed of the gases while radiant heat from gases is more effective at slower speeds, it is urgent to have high gas velocity only where the convection heat is strongly predominating. In other words, in the furnace itself as well as in the early tubes stretches, where the radiant heat is strong, boiler efficiency does not demand high gas velocities to attain satisfactory evaporation and it is only in the latter tube stretches where convection heat is markedly predominating, that unusually high gas velocities must be employed.

Tube lengths and evaporation

These conclusions are important in throwing new light on the whole question of combustion vs. evaporative efficiency. The high losses in unburnt fuel are primarily due to the fact that locomotive boilers have been so overloaded with tubes and tube area in striving for maximum evaporation that little room has been left for adequate combustion at the high gas velocities employed. Firebox volumes sufficient for slow firing rates prove totally inadequate at the higher firing rates and the gases are swept into the tubes too fast for complete combustion. Once in the tubes not only is the gas velocity speeded so much the more because of the restricted area available, but half of the total temperature drop along the tubes occurs in the first 25 per cent of their length. Hence, all further combustion ceases.

It would seem evident from these considerations that instead of having 20-ft. tubes and a 4-ft. combustion chamber, better results would be obtained were the tubes cut to 12 or 14 ft. in length and the additional six or eight feet added to the combustion chamber.

Experiment has shown that the first 12-ft of a 20 ft. locomotive tube causes approximately 79 per cent of the total temperature drop along the tube. When the higher specific heat of the gases at the higher temperatures is taken into account, this would mean that roughly 85 per cent of the total heat transmitted by the gases in their passage through the tubes is given up in the first 12 ft. of their length.

To collect the other 15 per cent when using shorter tubes would simply be a case of employing smaller bore tubes and thus reducing the hydraulic depth. Thus, for an initial temperature of 2,000 deg. the resulting smokebox temperature for a 20-ft. flue of 2¼ in. outside diameter and a given speed of gas flow would be about 560 or 580 deg. Suppose now we use tubes of 1½ in. outside diameter, and increase the number of tubes accordingly as permitted by the tube sheet area for the smaller bore tubes employed to take care of the same gas flow. Employing the formulas developed by Lawford Fry and others for temperature drops along tubes, it can be shown that tubes only 12 ft. long in the latter case will develop smokebox temperatures only 20 or 30 deg. in excess of the larger bore 20-ft. tubes used in the first instance. As a matter of fact the increased heat absorption in the larger combustion chamber should relieve the tubes of part of their burden, so that no appreciable difference should be noticed in the smokebox temperature.

Such small bore tubes, because of their shorter length, should give no more trouble in maintenance than the larger bore but longer tubes used today.

By adding the eight feet thus saved to the combustion chamber, a marked betterment in combustion efficiency should result. The unburned fuel particles would travel in the high temperature zone a sufficient length of time to become intimately mixed with the needed air, and to maintain their temperature long enough for more nearly complete combustion.

Of course it is realized that such a course would require changes in construction details of the first magnitude, particularly where a staybolted design were used. It is hardly likely, however, that staybolted designs will

continue to enjoy the same pre-eminence that they have in the past. It is not natural to hold pressures with flat surfaces. Watertube constructions are more apt to be trend of tomorrow. With these it should be possible to construct a zone of combustion varying gradually from the open areas of the firebox through widely spaced tubes in a long combustion chamber until the gases finally pass a dense tube nest before emerging into the smokebox. With such a design the widely variant nature of the heat from predominatingly radiant to predominatingly convection would be accommodated without interference with the completion of combustion itself.

Means of improving combustion efficiency

Other expedients besides the extension of the combustion space are of course possible for improving combustion efficiency and may be here briefly reviewed.

Increasing the grate area.—This reduces the rate of firing and the velocity with which the air passes through the fire, consequently lessening the tendency for unburnt coal particles to be wafted off with the gases. That locomotive designers appreciate this factor is seen in the ever increasing size of the grates, made possible of course by the use of stokers.

Increase in the cylinder ratios.—Aside from their beneficial effect in securing more even starting torque, an increase in the customary number of cylinders and a change in the angular ratio of the crank pins are recommended as benefiting combustion by reducing the pulsating character of the exhaust.

The writer is inclined to think that the harm done by the intermittent exhaust action, except at slow speeds, has been overrated and that it plays but a minor part in combustion losses compared with the excessive velocity of the gases through the firebox. When it is considered that a two cylinder locomotive will give four impulses per revolution or approximately sixteen per second at normal speeds it does not seem likely that the intermittency of this action will make itself felt as far back as the firebox, where it will assume more the proportions of a steady suction.

Fan draft.—The use of a fan draft would do away with the pulsating nature of the exhaust and produce a steady suction, but the remarks made in the paragraph above apply here as well. Fan draft has been tried on locomotives, but has failed of mechanical success because of the installation of fans totally inadequate for the volume of gases they had to handle.

Firebrick arches.—Arches have come into general use as an assistance in prolonging the path of combustion and are too well known to require further comment. Few locomotives are now built without them.

Preheated air.—In the effort to get more power, locomotives are sometimes driven to burn 150 to 175 lb. of coal per sq. ft. of grate per hour. It is found that not enough air can be sucked through the ordinary grate to attain this firing rate, so the firedoor is opened to admit the extra air found necessary. The draft suction then pulls this air on the shortest line from the door to the tubes, from *A* to *B* as shown in Fig. 2. Such air is in contact with the fuel particles a comparatively short time, and chills them below the temperature of combustion. It is not surprising that the unburnt fuel loss mounts up so rapidly, as a consequence, to 35 per cent of the total fuel fired.

The remedy for this condition would be in the use of preheated air admitted not at the door but just above the fire in the front waterleg as shown in Fig. 2, so that it would have to traverse the length of the firebox under the arch and around to get to the tubes. This would insure thorough mixing with the fuel particles in the gases and maintain them in an oxygenated atmosphere of the required temperature long enough for complete combustion.

The Ljungstrom Turbo-condensing locomotive built in Sweden has an interesting air-preheating feature. A series of air tubes runs from the front of the engine underneath the boiler to an enclosed ashpan. The velocity of the locomotive causes air to rush down these tubes at a speed which is regulated by a shutter control. The smokebox gases circulate around these tubes and preheat all air admitted to the ashpan.

Waste heat in the form of smokebox gases, exhaust steam or hollow jackets surrounding the boiler may be utilized for moderate preheating, but the writer believes that the day may come when preheating the air will be

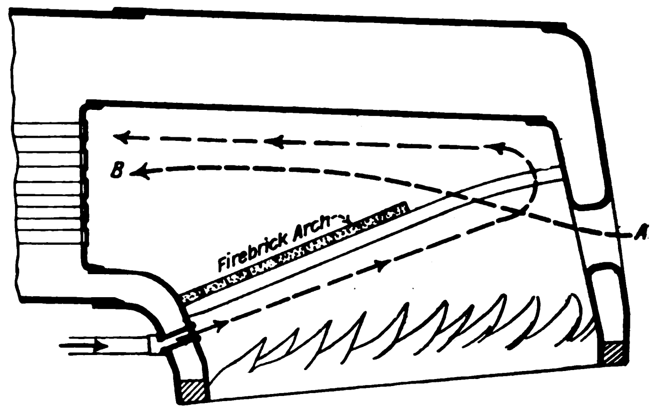


Fig. 2—The line A-B shows the course of the draft air from an opened firedoor. Suggested inlet where auxiliary preheated air is used

considered important enough to use active air heating in the tube zones of the boiler itself. Any waste heat saved would play but a minor role compared with the improved combustion efficiency and higher firing rates made possible in this way.

It is true that a considerable amount of air preheating would result in higher firebox temperatures that would seriously affect the safety of present type fireboxes. Watertube fire boxes with their better circulation and lack of crown sheet failures seem here again the natural solution.

Preheating the air supply is recognized as a necessity in the iron and steel industry. It may yet become a factor in solving the combustion efficiency problem on the locomotive and in making possible the successful forcing of the fires for power rates now unknown.

Powdered coal.—Powdered coal has been often suggested as one means of reducing the losses of combustion. One cubic inch of solid coal exposes only 6 square inches for burning, whereas a cubic inch of powdered coal exposes 20 to 25 sq. ft., so that theoretically at least thorough mixture with the required air and consequent rapid combustion should be a simple matter.

Practically, however, much difficulty has been encountered in burning it under boilers in the stationary field, where most of the pioneer work was done. Many failures resulted until it was found that it could be burnt with a fair degree of success where a sufficiently large furnace and combustion chamber were provided. The furnaces employed in most cases had a volume eight to ten times that of a locomotive firebox burning an equivalent amount of solid fuel, which put it beyond the pale of the locomotive field.

Stationary engineers are, however, now in the midst of experiments to devise means for more rapid com-

bustion of powdered coal in smaller furnaces, which are worthy of the attention of the railway world. Streamline combustion, in which the mixture of air and fuel took place slowly along a great length of stream, necessitating long combustion chambers and furnaces was the first successful method. It is now thought that ultimately opposing streams of air and powdered fuel may be employed to produce a vortex action, which will permit the use of a shorter flame and a smaller furnace. Should these attempts become successful their possibilities for locomotive use should not be overlooked.

It may then become practicable to install powdered coal injectors up near the smokebox end of a locomotive boiler, using a small stream of compressed air to blow the particles down a combustion chamber extending back to the firebox, which would be the real combustion chamber. Here a reversal of direction would occur and the flames sweep back through the tube areas, drawn by the exhaust suction.

Air tubes could be admitted from the smokebox end, carrying air forced through by the train velocity and preheated by the smokebox gases or other means to supply the auxiliary air required, placing the air jets at angles to the combustion stream to create the desired "vortex" action.

Such an arrangement may make possible the application of powdered coal burning to the locomotive as well as in the stationary field.

Fuel Association presents interesting report

Prevention of front-end air leaks and proper grate air openings important factors in fuel economy

NUMBERED among the many interesting reports presented at the eighteenth annual meeting of the International Railway Fuel Association, held at the Hotel Sherman, Chicago, May 11 to 14, was the report of the committee on front-end grates and ashpans. The report of the committee this year dealt with the prevention of front-end air leaks, the arrangement of ash pans, fireboxes and front ends of oil-burning locomotives, and the use of grates with restricted air openings.

In the section of the report dealing with oil-burning locomotives, the fact that cast steel fire pans are being employed to a considerable extent was recorded. It was also reported that the Atchison, Topeka & Santa Fe is eliminating arch tubes from its oil-burning locomotives, and by the use of a larger stack having an integral inside extension it has been possible to open up exhaust nozzles by 1/4 in. in diameter.

Prevention of front-end air leaks

Most roads report what they seem to regard as adequate front-end inspection with respect to air leakage, but there is good reason to believe that the ordinary inspection methods do not disclose all the air leaks, and that in this matter there is room for almost universal improvement. The committee has not inquired widely about inspection methods, having confined its requests chiefly to devices for preventing air leaks. Our correspondence has, nevertheless, made it clear that most roads carry on systematic and regular front-end inspection. One fairly typical statement in this connection is as follows: "We are careful to candle the smokebox and make every attempt to prevent any air leaks; we are careful in making our front-end ring joint tight, using hollow asbestos tape; we are careful to have our stacks properly fitted to the stack base, and the base to the smokebox; all bolts and all rivets that enter the smokebox are made air tight and inspections are made at the end of each locomotive trip."

One of our correspondents says that in his contact with shop men he occasionally finds that they do not understand the real purpose of making the front-end tight against leakage—that some of them think it is for the purpose of preventing the outward leakage of smoke. If any such misapprehension is common it certainly indicates the need for better and more systematic instruction of those responsible for front-end inspection and maintenance.

As has been indicated, there is reason to doubt the effectiveness of the ordinary methods of inspection, and in support of this opinion one road—in no way behindhand in matters of inspection and maintenance sent three photographs two of which are reproduced in these pages. They show the results of leakage tests on locomotives "which had made their mileage as they came to the shop for general overhauling." In making the tests the tubes were closed by fitting wooden plugs into the flues and tubes at the back flue sheet, and the nozzle was blocked; the front-end was then filled with water by means of a hose inserted into the top of the stack. Beyond pointing out the fact that the leakage shown takes place under an average head of water equivalent to only about one and one-half pounds per square inch, the committee has no comment to make. The committee suggested that these simple tests be widely applied in order to check the effectiveness of inspection methods.

Leakage around steam pipes

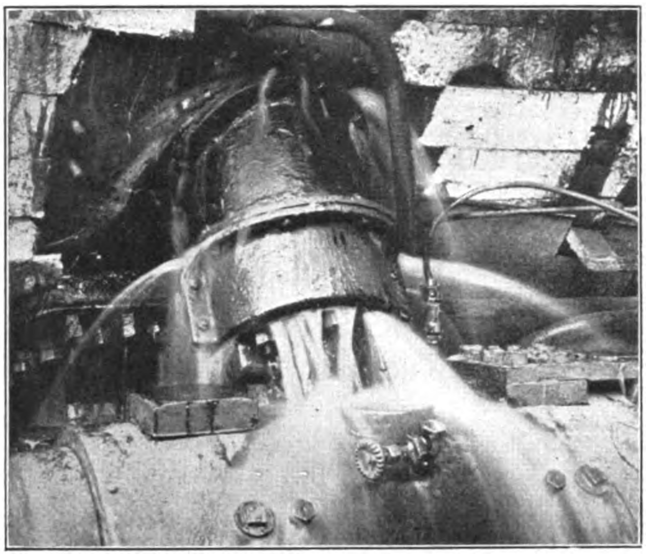
The various devices for the prevention of leaks around the steam pipes to which the committee's attention has been called are in the report. The committee's search was not exhaustive and there are doubtless other designs in use.

A 1/4-in. cover plate is fitted close around the steam pipe and is electrically welded to the pipe and to the smoke-arch. In the Manual of the Mechanical Division of the American Railway Association, Section F, page 76, there is shown a very similar device in which, however, the cover plate is dished instead of being flat. The plate in this case is applied on the inside of the smoke-arch and is welded to the pipe and the arch.

In preventing leakage around steam pipes the Southern Pacific used a 3/8-in. plate bolted to the smokebox with 15 or 16 3/4 in. bolts. This plate is split for convenience in applying it and the split is subsequently welded. To this plate is welded a cylindrical casing made of 1/8-in. material; and a steel ring is fitted into the bottom of the

casing. This steel ring is cut in half before applying it to the steam pipe. After being applied it is welded together, then welded to the casing; and finally it is welded to the steam pipe and the weld caulked. The space between the outside of the steam pipe and the casing is one inch wide.

The Chicago, Indianapolis & Louisville surround the steam pipe with a cast iron sleeve which is bolted to the smokebox; the contact surface of the casting at the smokebox is finished. This sleeve is cast in two parts which are bolted together along two flange and finished joint faces. The bottom of the sleeve carries a flange and a stuffing



Escaping water indicates more air leaks around steam pipe casing into the front end

box which is packed with asbestos rope. The jacket encircles the sleeve and extends to the smoke-arch.

Use of grates with restricted air openings

Last year the committee reported that in two railroads a radical departure had been made with respect to the total air opening through grates, which runs counter to the practice of securing the greatest possible air opening recommended by the committee. The A. T. & S. F., because of the waste due to fuel falling through the finger grates then in use, had changed to a table grate in which the individual air openings were greatly reduced. After the coal losses through the grate had been stopped, it was determined by means of gas analyses that more air than was required for proper combustion was being admitted, and the aggregate air opening through the table grates was reduced to as low as 16 per cent of the grate area. The committee also reported that the Northern Pacific, in trying to burn lignite coal, resorted to a similar practice, finally coming to a table grate with conical openings ½ in. in diameter at the upper grate surface, with the number of these holes such that the aggregate air opening was brought down to about 12 per cent.

This year, the report states, the committee in reply to letters, heard from 80 railroads on this subject, 55 of which have never deliberately restricted the grate opening, and 16 of which have reduced the size of the individual holes in the grates in order to reduce the loss of fine coal into the ash pan. In most instances, however, these roads have endeavored to keep the per cent of air opening as large as possible, generally from 35 to 45 per cent of the grate area.

Of the other nine replies, four only indicate clearly that material reductions in aggregate air opening have been made, reducing it to a total of from 14 to 19 per cent of the grate area. The St. Louis-San Francisco resorted to the practice in attempting to burn different grades of slack coals in locomotive service and obtain good results with table grates having 25/32-in. conical holes and an aggregate air opening of 19 per cent, with the draft slightly sharpened. The Chicago, Milwaukee & St. Paul, in order to burn lignite coal where this is available, has found that by the use of restricted grate openings a reduction of from 15 to 20 per cent fuel consumption is effected. The Oregon-Washington Railroad & Navigation Company already burning sub-bituminous coal on a table grate having about 43 per cent air opening, experimented with grates having air openings of 14 per cent, but failed to find any advantage in this grate. The Temiskaming & Northern Ontario developed grates in which the total air opening was reduced to about 16 per cent of the grate area on an engine equipped with an exhaust governor. The road reports, however, that the tests did not show any improvement in fuel consumption of this combination as compared with the fuel consumption of the locomotive before the exhaust governor was applied and the grate openings reduced.

Northern Pacific tests

The committee's report last year dealt at some length with the practice on the Northern Pacific where the grates

Table showing evaporation of Rosebud, Red Lodge and Roslyn coals on three different grates—Northern Pacific

	Equivalent Evaporation, Pounds of Steam per pound of coal.		
Kind of coal	On ¾ in. slotted grates	On ⅝ in. round hole grates	On ½ in. round hole grates
Rosebud	....	3.80	3.73
	....	3.95	3.82
	....	3.73	3.95
	....	3.93	4.00
	....	...	3.90
	....	...	3.74
Average evaporation	....	3.85	3.86
Relative evaporation	....	99.8	100.
Red Lodge	6.06	5.89	6.07
	6.14	5.69	5.78
	5.63	5.59	6.25
	5.70	5.85	6.07
	5.60	5.82	5.80
	5.71	5.92	6.07
Average evaporation	5.81	5.79	6.01
Relative evaporation	96.7	96.4	100.
Roslyn	6.51	6.61	6.01
	6.58	6.61	6.01
	6.34	6.64	6.39
	6.83	6.39	6.23
	6.69	6.77	...
	...	6.19	...
Average evaporation	6.59	6.54	6.28
Relative evaporation	104.8	104.1	100.

with restricted air openings were developed as a part of the program to burn Rosebud coal, a Montana lignite carrying 25.66 per cent moisture and a heating value of 8,743 B.t.u. Since that time results of the tests of these grates have become available. These were represented by the committee in the accompanying table. The Red Lodge coal referred to in the table is a Montana bituminous coal bearing 11 per cent moisture and a heating value of 10,000 B.t.u. The Roslyn coal, a Washington bituminous, has about 4 per cent moisture and 12,000 B.t.u. The tests were made on a locomotive with 28-in. by 32-in. cylinders; a total weight of 320,000 lb., of which 240,500 lb. is on the drivers; 30,591 sq. ft. of evaporating heating surface; 838 sq. ft. of superheating surface, and a grate area of 70.3 sq. ft. It develops a tractive force of 57,100 lb. The grate for which the results are given in the first column of the table has a total air opening of 36 per cent of the grate area; that

for which the results are shown in the third column has a total air opening of 13½ per cent of the grate area.

In connection with the Rosebud coal, attention is called to its low heating value and also to the fact that a high stack loss results from its lightness and friability. The table shows that the Red Lodge coal gives the best results with the grate having the smallest air opening, whereas with the Roslyn coal the best results are obtained with the larger air opening.

The committee quotes M. A. Dlay, general fuel supervisor, Northern Pacific, as follows: "I can sum up in a sentence what may be the keynote to the improvement that we experienced with all kinds of coal on the grate having restricted openings. It is simply that the results of the tearing effect and higher rate of combustion possible with larger volumes and velocity of air through larger grate openings are not obtainable through grates having smaller openings. In other words, there is less clinkering tendency through the ability to control the air flow through smaller individual openings than there is through the larger openings, and since the excess oxygen which is present in the stack gases is about the same with the restricted or unrestricted air openings, the air supply is presumably sufficient, and, being controlled, produces less clinkering."

In concluding, the committee made the following statement: "It is obvious from this record that the Northern Pacific in setting out to burn lignite coal, had to carry a thin fire bed, that it had to reduce the size of the individual holes in order to avoid disturbing this thin fire, and apparently with the draft prevailing in these engines it had to decrease the aggregate air opening through the grate in order to avoid an excess of air. The question arises whether this excess might not have been avoided by decreasing the draft; that is, whether after reducing the size of the individual holes the aggregate air opening through the grates might not have been kept in the neighborhood of 30 or 35 per cent, and the size of the nozzle increased."

The report was signed by Edward C. Schmidt (University of Illinois), chairman, J. S. Breyer (Southern), C. H. Holdredge (S. P.), V. L. Jones (N. Y. N. H. & H.), G. H. Likert (U. P.), John P. Neff (American Arch Company), J. L. Ryan (I.C.), C. B. Smith (B. & M.), G. A. Young (Purdue University) and F. Zeleny (C. B. & Q.).

Axle failures in cold weather

Are axle failures caused by crystallization? Are stresses increased by low temperatures?

By Norman Litchfield

IT seems to be the opinion of many mechanical department men that the number of axle failures in service is greater in cold weather than in warm weather. It is claimed that the larger number of failures is caused by a greater tendency of the metal to crystallize at low temperatures. As this is a question of considerable interest to motive power men, an attempt has been made in this article to assemble such data as is available in connection with the subject, which really resolves itself into four questions: First, is there a greater number of failures at low temperatures than at high? Second, are the failures caused by crystallization? Third, is steel inherently weaker at low atmospheric temperatures than at high? Fourth, are the stresses induced by a given load increased by low temperatures?

The first question may be answered, that the question is so often asked as to indicate that data is available to prove that an increase in axle failures during cold weather does occur, but we do not believe that any data proving this to be true has ever been published. There is always a matter of doubt in judging the accuracy of opinions held on such a subject. To arrive at a safe conclusion, carefully recorded data should be taken over a period of years, to show that an excessive number of failures has occurred with each recurrence of low temperatures. Supporting data is also necessary as to the nature of the break; whether it is a clean-cut snap, or whether it partakes of the nature of a gradual fracture. The latter is familiar to every one who uses steel subjected to constant shocks, vibrations and alternating stresses, such as occur in axles. The reason for laying down this condition is that when shafts of a given design and material fail after long continued rotation and are replaced with shafts of like design and material, it may be predicted with a fair degree of certainty that the new shafts will also fail, roughly speaking, after the same number of rotations, irrespective of temperature conditions, there being a sort of periodic life for a given shaft under a given stress. Both laboratory data and records from actual service confirm this statement. Considerable laboratory data is available, but comparatively little in the way of actual service records has been assembled. For such records, a good and continuing organization is required, coupled with a fair degree of patience, for the reason that the cycle may require a period of from eight to ten years, depending on the mileage made by the vehicle. Therefore, it must be proved that the occurrence of a large number of failures during cold weather has not happened to coincide with the end of the endurance cycle of a lot of shafts which were placed in service at about the same time. Furthermore, examination should be made to see whether the shafts were not about cracked through before they finally snapped in the cold spell. It is, of course, well known that a shaft will continue to run for a considerable time after it has cracked to such a point that only a surprisingly small section remains.

Closely allied with this subject is the question of how high is the normal working stress in the shaft. It is well known that the higher the working stress, the shorter will be the periodic life. This is substantiated by all the series of experiments which have been made both in this country and in Europe over the past 20 or 30 years. Service records show the same thing. One set of shafts of good design, but highly stressed, close to the elastic limit, has a quite definite periodic life,

whereas another set of the same general design and material, under a lower stress, shows an endurance life exceeding that of their resistance to wear at the bearings. It is, therefore, seen that all of the facts must be carefully analyzed before attempting to draw the conclusion that low temperatures are the cause of failures.

Assuming for the moment that this is the case, an analysis may be attempted of the possible reasons for such failures. In so doing, it may be simpler to consider the fourth question first; namely, are the stresses induced by a given load increased by low temperatures? This question almost answers itself in the affirmative, particularly in the case of car and locomotive axles. Faulty lubrication, a frozen road bed, sticky triple valves, frozen brake shoes, springs, etc., all tend to throw heavy and sudden strains on the axles, with consequent high stresses which may be accentuated and largely increased locally by poor design, such as sudden change in section, sharp fillets, keyways and other defects. Whether these increased stresses, which are difficult to determine, will be sufficient to bring about failure of an axle that would otherwise be safe, will depend largely on the intensity of the normal working stress in the shaft and its relation to the inherent resistant properties of the steel.

It being granted then that cold weather does tend to increase the stresses in shafts, there then arises the question as to whether the ultimate failure is caused by crystallization, by which is meant some change in the molecular structure of the steel, changing it from a granular substance to a crystalline one.

That some such change does take place is the opinion which is held by many in the practical field, but it is a theory which is thoroughly discredited by metallurgists. It is, however, not to be wondered at that many users of steel should hold to this opinion. A fracture in service often possesses a highly crystalline appearance, particularly in the case of a shaft which has cracked part of the way through over a period of time (a so-called gradual or progressive fracture) to the point where the remaining section is so small that it can no longer resist the strains imposed on it and the shaft suddenly snaps off. The user probably knows that the axle material when purchased new was tested in a tension machine and at that time showed a fine granular structure. If he cuts a piece from the broken axle as close as possible to the fracture and tests this specimen in the tension machine, he will probably find that it breaks with the original granular fracture, free from any sign of crystals. The natural inference is, therefore, that the steel had crystallized just at the point of failure and presumably nowhere else. But if he were to take and polish a specimen from the very fracture itself, etch it and examine it microscopically, he would find the original character of material, which proves quite clearly that no action has taken place, such as is expressed and implied by the word crystallization. The very same steel when new, had it been tested by first nicking slightly, holding in a vise, and then striking a sharp blow tending to bend it at the nicked section, would have broken or snapped off, showing a crystalline fracture. In other words, it may be positively stated that there is no such thing as crystallization of steel caused by long continued service. Whatever crystalline appearance there may be at the break comes only from the nature of the break, the inherent character of which is considerably different from that occurring in a tension machine, being more nearly akin to a nicked break.

Another term which has long been applied to such failures is "fatigue"—a term which apparently grew up from an impression that under long continued strain the very nature of quality of the steel changes or weakens in the same manner that a muscle weakens, so that it can no longer resist strain. This impression also is not borne out by laboratory and microscopic investigation. The word "fatigue" is still largely used by metallurgists, but it is tacitly agreed that the word is not to be taken as implying any sudden deterioration of the metal, but rather a gradual cleaving apart of the steel, particle by particle. This cleavage naturally starts with the fibres nearest the surface which are under the greatest strain, and as they break one by one the cleavage gradually progresses towards the center.

Altogether, the evidence is conclusive that shafts do not break by reason of any change in their crystalline structure. We may, therefore, pass on to the question whether any change occurs in the strength of the steel itself when subjected to low atmospheric temperatures. Existing data on this subject is somewhat meagre. While numerous experiments have been made on the behavior of steel under high temperatures, these experiments have been brought about by the wide use of steel in furnaces and mills which have to operate at high temperatures, and there has not been a similar widespread use of steel at correspondingly low temperatures to force many series of experiments under these conditions. In the last edition of J. B. Johnson's work on "Materials of Construction," it is stated "When steel specimens are exposed to temperatures below the freezing point of water, the static strength is higher and the ductility lower than at normal temperatures." As an example, he cites a test made at the U. S. Arsenal in Watertown in 1905, but it will be noted that this test was made by plunging the steel specimen in a bath of liquid air, the temperature of which was —220 deg. F., a temperature which, of course, is far below any atmospheric temperature even in the most rigorous climate. Hence, it has but little bearing on the behavior of steel at low atmospheric temperatures. As an indication, however, and merely as that, the results of the test may be quoted:

	At room temperature, + 76 deg. F.	At liquid air temperature, — 220 deg. F.
Ultimate tensile strength, lb. sq. in.	72,300	97,600
Elastic limit, lb. sq. in...	52,800	80,000
Elongation, per cent	29.3	10.7

The Engineering Record, July 21, 1906, in quoting the results of the above tests at the Watertown Arsenal, makes this statement: "The results of these experiments are similar to those that have been obtained by numerous other experimenters who have investigated the properties of steel under the same conditions, in that it is shown that a great increase is produced in the tensile strength of steel at low temperatures with a corresponding decrease in ductility." Unfortunately, for our purposes, it does not state who the "numerous experimenters" were. It may be pointed out that the decrease in ductility above observed does not necessarily mean that the material has become less able to resist shock and vibration. The evidence of these tests is not sufficient in itself to prove that steel is weakened by cold.

An early English reference to this subject is found in the Proceedings of the Institute of Civil Engineers, Vol. CXII, in which a description is given of some tests made in Austria in 1892 as a result of some breakages of gun carriages in that country. In these tests, specimens were subjected to two kinds of impact test, longitudinal and transverse, the test pieces being cooled in a solution of ice and salt at a temperature of 4 deg. F. They were plunged in this mixture after each blow. The uncooled specimens were tested at a mean temperature of 68 deg. F. The bars used for the transverse test were nicked with a file across the middle on the under side, and had dropped on them a weight of about eight pounds from a

height of six inches. It was found that the resistance to transverse impact was less at low than at normal temperatures; a smaller number of blows being required to produce rupture. The resistance to longitudinal impact was increased "to a remarkable extent by the reduction in temperature, while the elongation also became greater." It may be noted that this statement is somewhat at variance with the results of the Watertown Arsenal tests in liquid air, above quoted, wherein the static elongation was found to be decreased by the liquid air temperature. A summary of the Austrian tests follows:

	Longitudinal impact		Transverse impact		Tensile tests		Condition,
	No. of blows causing rupture	Elonga-tion, per cent	No. of blows causing rupture	Deflec-tion at middle, inches	Break-ing stress, tons per sq. in.	Elonga-tion, per cent	warm or cold
Gun carriage steel...	13.0	13.0	26.6	0.6	30.7	24.8	Warm
	26.6	36.4	9.4	0.17	30.09	26.7	Cold
Axle steel unhardened .	13.6	14.8	11.4	0.307	....	....	Warm
	30.3	24.1	5.2	0.165	....	....	Cold
Axle steel hardened	1.0	....	1.0	....	....	....	Warm
	1.0	....	1.0	....	....	....	Cold

It must be remembered, of course, that these tests were made well before the development of modern methods

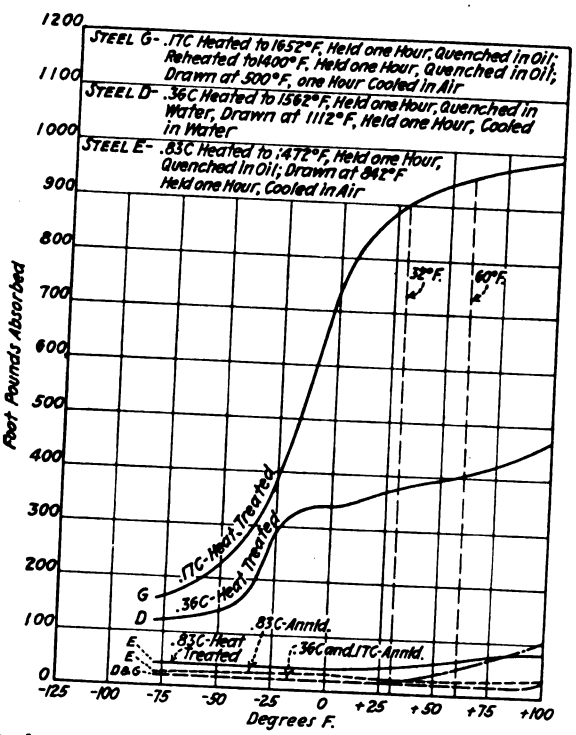


Chart showing the resistance to impact of three steel specimens at temperatures below 100 deg. F.

of heat treating steel, which probably accounts for the abrupt failure of the "hardened" axle steel.

An exceedingly interesting review of the history of the behavior of steel at various temperatures was given in a paper presented before the American Society for Testing Materials in 1924 by H. J. French and W. Tucker, entitled "Available data on the properties of irons and steels at various temperatures." The authors appended a bibliography of the subject, but it is found that, as usual, it refers mostly to the behavior of steel at high temperatures. However, one significant reference is made to a paper in the 1923 Year Book of the American Iron & Steel Institute describing an investigation of the influence of temperature on the Charpy impact value of a group of steels of varying composition, by F. C. Langenberg, metallurgist of the Watertown Arsenal, Watertown, Mass.

In the Charpy test a mounted pendulum is swung about a point and is capable of delivering a blow of about 217 ft. lb. The face of the pendulum is a hardened steel knife edge, rounded to a radius of about two millimeters. The test specimen is a small bar about 10 by 10 by 60 mm., and is notched to a depth of 5 mm. at the center. The pendulum strikes the specimen on the face opposite the notch and fractures it as a beam—chopping it in two, after which the pendulum ascends to an angle which depends on the energy remaining after the impact. Knowing the weight of the pendulum and the height of its center of gravity before impact, the energy of the blow can be determined. The height to which the center of gravity of the pendulum ascends after impact permits the determination of the energy remaining after impact. The difference between these two quantities is the energy absorbed by the test specimen and is the index of the resistance to impact of the specimen. While it is not contended that this test, by itself, gives a complete indication of the ability of a material to resist continued vibration and shock, yet it is in one way a very significant test, and one which, when taken into consideration with other tests and with microscopic examination of the grain structure, helps to obtain a good measure of the material. Mr. Langenberg gives results of his tests with three straight carbon steels, the first having a carbon content of 0.17 per cent; the second, 0.36 per cent, and the third, 0.83 per cent. All three steels were tested in the plain annealed state and also after heat treating. The heat treatment given to the soft .17 per cent carbon steel consisted of quenching in oil, and drawing and cooling in air. That given the mild .36 per cent carbon steel consisted of quenching in water, and drawing and cooling in water. The heat treatment of the hard .83 per cent carbon steel included quenching in oil, and drawing and cooling in air. Each heat treatment was calculated to give the best structure for developing the resistant powers of the material.

Mr. Langenberg states that in considering the heat treated condition "it may be remarked that the low carbon steel had received a treatment corresponding to that received by the core of a casehardened article; the medium carbon steel, a quench and a draw such as would be given when the material is used for structural parts. These steels were tested at temperatures from 80 deg. F. to high temperatures, which we are not concerned in this article. We have redrawn from the curve given in Mr. Langenberg's paper that portion which lies between 100 deg. F. and 32 deg. F., this being the range in which we are more particularly interested. This is shown in the chart. Mr. Langenberg states that "at a temperature of zero deg. F. and lower, there is practically no difference in resistance to impact when these steels are in the annealed condition." This is the only comment he has to make on the tests of the steels below the freezing point of water, his interest evidently being greater in the behavior of the steels at high temperatures. Luckily, however, he presents data sufficient to show the conditions at lower temperatures, and we have, therefore, replotted the curve to a scale which emphasizes the conditions below freezing. An xamination of thse curves shows three things quite clearly:—

First—The .83 per cent high carbon steel shows little or no difference in resistance to impact between the annealed and the heat treated conditions, its value being low in both and varying but little with change in temperature. To us, this is of more or less academic

interest only as this character of steel would not normally be used in railway equipment.

Second—The medium .36 per cent carbon steel is of a composition that makes it fall well within the axle class. Its tensile properties in the annealed state and when heat treated, were as follows:

	Yield point, lb. per sq. in.	Tensile strength, lb. per sq. in.	Elongation in 2 in., per cent	Reduction in area
Annealed	35,500	71,500	25.6	39.2
Heat treated	47,500	81,650	26.0	60.6

The 0.17 per cent carbon steel, which coincides with the .36 per cent curve until it passes + 25 deg. F. and then rises, although somewhat soft, may also be used by some for axles. In the annealed state, the resistance to impact of both the .17 per cent carbon steel and the .36 per cent steel are very low, but it is significant that the value stays nearly even between 60 deg. F. and 50 deg. F. Heat treating these steels apparently greatly increases their resistance to impact, being at 60 deg. F. some 20 times as great as in the annealed state. But with these steels in the heat treated condition, temperature changes have a marked effect. Calling the resistance 100 per cent at 60 deg. F., the relative values are:

Temp. deg. F.	0.17 per cent carbon	0.36 per cent carbon
+60	100	100
+32	94	95
0	76	85
—25	42	68
—50	24	35

It should be noted that even the reduced values of the heat treated materials at low temperatures are higher than any of the values, hot or cold, of the plain annealed materials. It would be interesting to ascertain whether future tests will bear out the figures given above and to have a study made of the causes of the change in value.

A special committee of the American Society for Testing Materials is studying the effects of temperature changes on the resistance of steel to impact and the hope is expressed that in considering the major subject of high temperatures, they will not overlook the lesser but important subject of low atmospheric temperatures. It would seem that the railroads might supply service data which would serve to amplify the committee's laboratory experiments.

In conclusion, we believe that it may be safely stated that cold weather does not cause crystallization, meaning thereby a permanent change in the crystalline structure. The same steels which showed a lessened resistance to impact at the low temperatures would undoubtedly regain their original properties when warmed again. It further appears that a proper heat treatment increases the resistance, but if in the design advantage has been taken of the increased tensile properties to reduce the diameter, thereby increasing the working stress, it is entirely possible that low temperatures may cause failure. These facts should, therefore, be taken into consideration in the design.

The available data is so meagre as to make it only possible in this article to point out the situation and express the hope that the subject may be carried further by those in a position to do so.

THE AVERAGE COST of coal used as fuel for road locomotives in freight and passenger train service and charged to operating expenses was $2.64 per ton in the first four months of this year, according to the Interstate Commerce Commission's monthly bulletin of railroad fuel statistics. This compares with $2.81 in the corresponding period of last year. The cost of fuel oil averaged 2.9 cents per gallon, as compared with 3.12 cents last year. The total cost of coal and fuel oil for the four months was $110,536,495, as compared with $112,693,960 last year. For April the average cost of coal was $2.65 and the average cost of oil was 2.92 cents.

Safety record at El Paso shops of the Southern Pacific

THE splendid record of the United States railroads in the conservation of life and in the reduction of injuries to employees, is well illustrated in the performance of the El Paso shops of the Texas and Louisiana lines of the Southern Pacific, which, according to a recent report from H. M. Mayo, superintendent of safety, have operated for over 27 months with but two injuries to the employees which classified as "reportable" according to the requirements of the Interstate Commerce Commission.

The El Paso shops employ an average of 650 men. In addition to roundhouse repairs, the plant is equipped for general and heavy repairs to locomotives and equipment and handles the heaviest type of power on the system, including Mountain and Pacific type locomotives in passenger service and 2-10-2 type operating both east and west of the Rio Grande.

During 1924 the plant worked 1,645,172 man hours, and during 1925 approximately the same. Adding the monthly average to include November and December of 1923, and January, 1926, brings the total man hours worked in the El Paso shops for 27 months of record to 2,734,701 hours against which is charged but two "reportable" injuries, or two injuries necessitating a loss of time of more than three days.

The management of the Texas and Louisiana lines of the Southern Pacific naturally feel pround of this fine record and give credit to the officers of the El Paso division and to the shop foremen and employees for the commendable results which have attended their efforts to create a safe shop.

Incidentally, the shops of the system located at Algiers, La., during 1924 reported one injury for each 357,721 hours worked, and for 1925 had decreased the number of injuries from seven in the previous year, to but three for 1925, working 747,753 man hours per injury. The rivalry between the two shops has been keen for several years. Prior to 1924 the Algiers shops had won the safety banner for three successive years. El Paso shops, however, won this much sought for award for 1924 and 1925.

The record of the five important shops of the Texas and Louisiana lines of the system for 1924 as compared with 1923 shows a reduction of 275 or 67 per cent. The reduction for 1925 compared with 1924 was 39 per cent, there being 131 reportable casualties in 1924 and but 80 in 1925.

Entrance to the Department of Railway Engineering, University of Illinois

Examples of recent locomotives of the 2-10-0, 2-10-2 and 2-10-4 types

Arranged in order of type and weight

Type	2-10-0	2-10-0	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-3	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-2	2-10-4
Railroad	Penn.	G. M. & N.	Penn.	B. & O.	Gt. Nor.	Can. Nat.	C.B. & Q.	C. R. I. & P.	A. T. & S. F.	So. Pac.	Wab.	A. C. L.	B. & M.	I. C.	U.S.R.A.	U. P.	U.S.R.A.	T. & P.
Road class or number	L-1-s	251	N. 1-s	S-1	Q 1	T-2-A	E-5-C	3,030	3,800	F-4	2,507	Q—1	3,006	3,025	Heavy	5,515	Light	600
Builder	Bald.	Bald.	A. & B.	B. & L.	Bald.	Can.	Bald.	Amer.	Bald.	Bald.	Amer.	Bald.	Amer.	Lima	A. & B.	A.B. & L.	A. & B.	Lima
Ordered or built	1922	1923	1918	1923	1923	1924	1922	1925	1924	1923	....	1925	1923	1922	1918	1924	1918	1925
Tractive force, engine, lb.	87,000	60,000	80,940	82,800	87,000	80,200	75,500	77,800	81,500	75,150	69,700	75,700	71,300	73,800	74,000	70,450	69,400	83,000
Tractive force, booster, lb.	.....	.....	.....	.....	.....	11,535	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,000
Cylinder horsepower (Cole)	.....	2,421	3,325	3,568	3,630	3,030	3,000	3,244	3,406	3,136	2,954	3,163	2,878	3,082	3,082	3,136	2,624	3,787
Speed m.p.h. at 1,000 ft. piston speed	34.6	33.96	34.6	35.7	35.16	31.8	33.5	35.16	35.16	35.44	35.72	35.16	34.05	35.16	35.16	37.5	31.8	35.3
Weight of engine, lb.	371,800	251,100	435,400	434,500	422,340	309,240	405,710	405,000	400,490	398,000	395,000	391,980	357,000	381,000	380,000	365,623	352,000	448,000
Weight on drivers, lb.	342,050	225,500	351,300	344,500	342,490	321,780	312,510	317,500	316,760	306,000	314,000	333,060	299,000	296,500	293,000	288,877	274,000	300,000
Weight on front truck, lb.	29,750	26,600	23,100	32,000	24,720	28,780	32,740	27,000	30,840	31,500	28,500	27,120	25,000	28,500	28,500	28,423	23,000	41,800
Weight on trailing truck, lb.	.....	....	61,000	58,000	55,130	58,680	60,460	60,500	52,890	60,500	52,500	61,800	33,000	56,000	58,500	48,323	54,000	106,200
Weight of tender, lb.	182,200	182,400	211,300	294,200	286,160	245,800	225,800	223,600	286,510	223,000	196,900	221,020	205,500	209,000	206,100	235,877	206,100	275,200
Wheel base, driving, ft. and in.	22—8	20—0	22—2	22—4	22—0	21—8	20—9	22—6	22—0	22—10	22—10	22—10	21—10	22—4	22—4	22—6	21—0	22—0
Wheel base, engine, ft. and in.	32—2	28—11	41—11½	42—11	42—7	42—2	40—1	42—7	41—1	42—4	42—4	42—9	39—7	42—2	42—2	41—5	40—4	46—8
Wheel base, engine and tender, ft. and in.	73—0½	65—1	82—7¼	89—10⅞	89—9⅝	80—9¾	79—5	82—8	85—2⅛	82—7½	78—4¼	83—0½	79—1	82—10	82—10½	79—6	75—11½	86—8
Cylinders, diameter and stroke, in.	30½x32	25x30	30x32	30x32	31x32	29x32	30x32	30x32	30x32	29½x32	29x32	30x32	29x32	30x32	30x32	29½x30	27x32	29x32
Driving wheels, diameter, in.	62	57	62	64	63	57	60	63	63	63½	64	63	61	63	63	63	57	63
Steam pressure, lb.	250	215	205	220	210	200	185	200	210	200	195	195	190	190	190	200	200	250
Fuel	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Oil	Bit. coal	Bit. coal	Bit. coal	Oil	Oil	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Oil	Bit. coal	Oil
Boiler, diameter, first ring, in.	84½	76	88¼	90	90	84½	96	84	88	90	86	88	84½	88	88	86¼	86	86½
Firebox, length, in.	125½	108⅛	144	132⅛	132	120	131⅞	120⅛	132 1/16	132	120⅛	132⅛	150⅛	132⅛	132⅛	126	114⅛	150⅛
Firebox, width, in.	79⅞	86¼	80	96	96	96¼	96	96¼	96	90	96¼	96¼	96¼	96¼	96¼	96	96¼	96¼
Tubes, number and diameter, in.	114—2¼	217—2	196—2½	232—2¼	270—2⅛	264—2¼	264—2¼	210—2¼	255—2¼	261—2¼	253—2¼	256—2¼	320—2	271—2¼	271—2¼	260—2¼	247—2¼	82—2¼
Flues, number and diameter, in.	200—3¼	36—5⅜	54—5½	53—5½	60—5½	60—5½	45—5½	50—5½	54—5½	50—5½	48—5½	50—5½	50—5⅜	50—5½	50—5½	45—5½	45—5½	184—3½
Length over tube sheets, ft. and in.	19—1	17—6	20—10¾	23—0	21—0	21—6	22—7½	23—1	20—9	21—0	23—0	20—6	19—0	20—6	26—6	22—0	20—6	21—6
Grate area, sq. ft.	69.6	64.7	80	88	88	80.3	88	80.3	88.3	82.5	80.2	88.2	80.3	88.2	83.2	84	76.3	100
Coal rate, lb. per sq. ft. grate per hr. (Cole)	....	122	135	132	134	122.5	111	131.5	125	123.5	120	117	116.5	113.5	113.5	121.5	111.8	123
Steam required per hour, lb. (Cole)	....	50,400	69,200	74,200	75,500	63,000	62,400	67,500	70,800	65,200	61,450	65,800	59,900	64,200	64,200	65,200	54,600	78,700
Heating surface, firebox, total, sq. ft.	312	229	423	375	477	356	381	445	417	381	379	426	303	432	429	341	373	473
Heating surface, tubes and flues, sq. ft.	4,506	2,862	4,302	4,876	5,134	5,178	4,966	4,495	4,711	4,722	4,991	4,549	4,498	4,728	4,727	4,774	4,293	4,640
Heating surface, total evap., sq. ft.	4,818	3,091	4,725	5,251	5,611	5,534	5,347	4,940	5,128	5,103	5,370	4,975	4,801	5,160	5,156	5,115	4,666	5,113
Superheating surface, sq. ft.	1,986	693	1,618	1,512	1,518	1,558	1,246	1,424	1,405	1,329	1,129	1,230	1,167	1,285	1,230	1,252	1,085	2,100
Comb. evap. and super. surface, sq. ft.	6,804	3,784	6,343	6,763	7,129	7,092	6,593	6,364	6,533	6,432	6,499	6,205	5,968	6,445	6,386	6,367	5,751	7,213
Tender, water capacity, gal.	9,000	8,500	10,000	15,800	15,000	13,200	12,000	12,000	15,000	12,000	10,000	12,000	12,000	12,000	12,000	12,000	10,000	14,000
Tender, fuel capacity, tons or gal.	17½	18	20	23	5,000	16	22	18	5,000	4,000	18	16	16	16	16	5,200	16	5,000
Weight on drivers ÷ weight eng. per cent.	92.1	89.9	80.7	79.2	81.1	78.5	77.1	78.4	79.1	76.9	77.0	77.3	83.7	77.7	77.1	79.0	77.8	67.0
Weight of drivers ÷ tractive force	3.93	3.76	4.34	4.16	3.94	4.01	4.14	4.08	3.89	4.07	4.51	4.00	4.19	4.02	3.96	4.10	3.95	3.62
Weight of engine ÷ cylinder horsepower	....	103.7	130.9	121.8	116.3	135.0	135.2	124.8	117.6	126.9	133.7	123.9	124.0	123.6	123.2	116.9	134.1	118.3
Weight of engine ÷ combined h.s.	54.6	66.3	68.6	64.2	59.2	57.7	61.5	63.6	61.3	61.9	60.8	63.2	59.8	59.1	59.5	57.4	61.2	62.1
Comb. heat. surface ÷ cylinder horsepower	....	1.56	1.88	1.89	1.96	2.34	2.20	1.96	1.92	2.05	2.20	1.96	2.07	2.09	2.07	2.03	2.19	1.90
Tractive force ÷ comb. heating surface	12.78	15.85	12.76	12.24	12.20	11.32	11.45	12.23	12.47	11.68	10.73	12.19	11.94	11.45	11.58	11.06	12.07	11.5
Tractive force × diam. drivers ÷ comb. h. s.	793	904	791	782	769	644	687	771	785	742	686	768	728	721	730	697	687	725
Cylinder horsepower ÷ grate area	....	37.42	41.56	40.55	41.26	37.65	34.08	40.40	38.55	38.01	36.83	35.88	35.84	34.94	34.94	37.32	34.40	37.87
Comb. heat surface ÷ grate area	97.8	58.5	79.3	76.9	81.0	88.3	74.9	79.2	74.0	78.0	81.1	70.4	74.4	73.1	72.4	75.8	75.4	72.1
Firebox heating surface ÷ grate area	4.48	3.54	5.29	3.52	5.42	4.43	4.33	55.4	47.3	46.2	47.2	48.3	3.77	49.0	4.87	4.06	4.90	4.73
Firebox heat. surface per cent evap. h. s.	6.48	7.41	7.96	4.73	8.50	6.43	7.12	9.01	8.13	7.47	7.06	8.56	6.31	8.38	8.32	6.67	7.99	9.24
Superheating surface per cent evap. h. s.	41.2	22.4	34.2	22.3	27.1	28.1	23.3	28.8	27.4	26.0	21.0	24.7	24.3	24.9	23.8	2.45	23.3	47.1
Notes	b-e-f-k	b	a	b	b	a-g	b-e	a-d	b-e	b-e	a	b	a	b	b	a	b	b-d-e-g-k

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; d-Syphon; e—Feedwater heater; f—Limited cut-off; g—Booster; k—Type E superheater.

A Consolidation Type locomotive built in the Canadian National Shops at Winnipeg, Man.

C. N. builds 2-8-0 locomotives from surplus material

THE Canadian National has just completed at its Transcona shops, near Winnipeg, Man., two Consolidation type locomotives which are the first locomotives built by this road in their own shops and which are also the first locomotives built in western Canada. There are sixty of this type on the western region which were built in 1911 and 1912, and which have proved to be the most satisfactory class of power of their size in service on this territory.

They are of rugged construction with satisfactory boiler capacity and with wide fireboxes. These locomotives have proved to be very economical as regards maintenance both of the boilers and the machinery.

This class of locomotives may be used for either freight or passenger service as they have enough speed to handle ordinary passenger trains in this territory when required. In territory where traffic is not too heavy they are used for main line time and drag freight trains, as in this region, where the main line grades do not exceed .4 per cent, the regular rating for this class of power is 2,730 equated tons.

Because of the rugged construction of these locomotives they have been found to require a minimum of repairs. As a result it was decided to build the two new locomotives partly to make use of spare parts which were in stock and which were found to be surplus. The new locomotives therefore, are in the main, reproductions of these consolidation locomotives built in 1911 and 1912, but many economy devices have been added to make them modern. The 8½-in. cross-compound air compressor has been applied on the right side to provide ample space for the application on the left side of the constant flow pump of the Elesco feedwater heater.

One pair of frames was supplied from the Canadian Steel Foundries, Montreal, and one pair of cylinders from the Point St. Charles shops of the Canadian National, Montreal. Similar parts for the first engine was surplus material on hand in stock at Transcona. With the exception of these parts and the engine deck casting, all steel castings for the new engines were furnished by the Vulcan Foundry, Winnipeg, and all brass castings by the North Western Brass Company, Winnipeg.

The grey iron castings were made in the Canadian National Foundry at Transcona and all forgings including the main and side rods, motion parts, axles, etc., were made in the Transcona shops.

Table of dimensions, weights and proportions

Railroad	Canadian National
Type of locomotive	Consolidation
Service	Freight
Cylinders, diameter and stroke	21½ in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6 in.
Outside lap	1 in.
Exhaust clearance	Line and line
Lead in full gear	3/16 in.
Weights in working order:	
On drivers	187,300 lb.
On front truck	27,000 lb.
On trailing truck	None
Total engine	214,300 lb.
Tender	172,100 lb.
Wheel bases:	
Driving	17 ft.
Rigid	17 ft.
Total engine	25 ft. 9in.
Total engine and tender	59 ft. 2 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	34¼ in.
Trailing truck	None
Journals, diameter and length:	
Driving, main	9½ in. by 12 in.
Driving, others	9 in. by 12 in.
Front truck	6½ in. by 12 in.
Trailing truck	None.
Boiler:	
Type	Extended wagon top
Steam pressure	205 lb.
Fuel, kind	Bituminous
Diameter, outside first ring	66⅛ in.
Firebox, length and width	96⅞ in. by 75¼ in.
Tubes, number and diameter	166—2 in.
Flues, number and diameter	26—5⅜ in.
Length over tube sheets	14 ft. 1⅜ in.
Grate area	50.62 sq. ft.
Heating surfaces:	
Firebox and arch tubes	231.4 sq. ft.
Tubes and flues	1,741.54 sq. ft.
Total evaporative	1,972.94 sq. ft.
Superheating	465 sq. ft.
Comb. evaporative and superheating	2,437.94 sq. ft.
Tender:	
Style	Rectangular
Water capacity	7,500 gal.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 per cent	38,000 lb.
Cylinder horsepower (Cole)	1,581
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	88.7
Weight on drivers ÷ tractive force	4.93
Total weight engine ÷ cylinder hp	133.3
Total weight engine ÷ comb. heat. surface	86.9
Boiler proportions:	
Comb. heat surface ÷ cylinder hp	1.54
Tractive force ÷ comb. heat. surface	15.6
Tractive force × dia. drivers ÷ comb. heat. surface	985
Cylinder hp. ÷ grate area	31.25
Firebox heat. surface ÷ grate area	4.56
Firebox heat. surface, per cent of evap. heat. surface	11.71
Superheat. surface, per cent of evap. heat. surface	23.59

These locomotives are equipped with Franklin, No. 8 butterfly firedoors and automatic driving box wedges, Pyle National headlight equipment, Detroit five-feed hydrostatic lubricator, King metallic packing, Franklin radial buffer, Barco joints, Huron arch tube and wash-out plugs and with the Westinghouse E. T. air brake equipment.

After the various parts were fabricated, the frames for engine No. 2747 were laid down on March 11 and the locomotive was completed by April 19, a total of 27 working days being required to erect and complete the engine. This additional work was over and above the ordinary shop output on repairs to other locomotives which was not interfered with in any way.

The frames for the second engine, No. 2748, were laid down on April 15 and the locomotive was completed on May 19.

After the trial trips were made, these engines were used on main line time freight trains in the Alberta district where the best use can be made of this type of locomotive and where the fuel saving devices with which they are equipped will be able to give the most economical results.

Drafting locomotives to secure increased efficiency*

YOUR committee thinks that the problem is: How are we going to regulate air openings into the ash-pan through the grates and fire-bed to admit the proper amount of air? Let us see what is being done by some of the roads. One of the large roads has installed a table grate with 18 per cent air openings, which they claim is giving ample air for good combustion and materially reduces fuel losses through the grates when firing up in terminals and in service on the line. In connection with this, they are using on all their large power double ported nozzles, which have separate cavities for the exhaust of each cylinder; the exhaust from one side comes through the dumbbell-shaped opening in the nozzle stand, while the exhaust from the other sides comes out of the two holes on each side of the dumbbell opening. Indicator cards taken show a reduction of back pressure by the use of this type of nozzle as compared to the standard one formerly used.

Other companies are adopting grates with as high as 55 per cent air openings and claim by doing so they are able to increase the size of nozzle tips and get a better draft, save fuel and make much longer runs without cleaning fires.

The size and length of the stack is often mentioned in connection with the draft of a locomotive. At the present time, however, the length of the stack is governed largely by the height of the overhead bridges, tunnels, etc.; therefore this feature cannot be considered, and it is the opinion of your committee that by increasing the diameter of the smoke-stack good results will be obtained. Tests made on a large passenger engine with a 20-in. stack at a speed of 60 miles an hour with 200 lb. steam pressure showed a 4-in. vacuum in the smoke-box. This same engine had the stack changed to one of 25-in. diameter, and, under the same conditions, showed a vacuum of 4.5-in., indicating that the velocity of the exhaust had been retarded by coming in contact with the inner surface of the smaller stack and that the entrainment of the gases had been facilitated by the use of the larger stack.

It has been stated at previous conventions that the petticoat or lift pipe is more economical on fuel than the extension stack. As both serve the same purpose, that is, to line the exhaust steam with the stack and carry the gases out of the smoke-box, we can see nothing in favor of the former over the latter in the way of saving fuel, but there is this in favor of the extension stack that there is not the trouble with its coming loose and causing steam failures, and if it is adjusted correctly and of the proper size we believe that its use is an advantage over that of the petticoat or lift pipe.

As to the proper amount of air openings with oil burning locomotives, it is understood that this depends on the size of the locomotive (that is, the fire-box area), and is determined in different ways. Sometimes it is figured according to the area of flue openings, making the air intake to the fire-pan equal to 40 per cent or 45 per cent of flue openings; and in other ways by the area by volume of cylinders, the figure .027 times the volume of one cylinder being used; as an illustration, for a 25-in. by 28-in. cylinder Pacific type passenger engine this amounts to 370 sq. in. It has been found, however, that engines equipped with this amount of air openings in the fire-pan make considerable gas and smoke if an excess of oil is used by the slightest opening of the firing valve. In order to avoid this and produce better combustion the air openings are increased by cutting an opening on each side of the fire-pan 5-in. wide and 10-in. long near the bottom of the fire-pan, just forward of the regular air opening in the rear of the pan. This makes an addition of about 100 sq. in. added to the rule for proper air openings on the size of engines referred to. By using this addition of air openings on larger engines in proportion to what they formerly had, as figured by this rule, it not only increases the steaming qualities of the engine, but decreases the fuel consumption. Still another formula is to take the volume of one cylinder (that is, its diameter multiplied by the stroke), then use 2.7 per cent of the total for the air openings in the fire-pan, dividing this in the proportion of 15 per cent around the burner and 85 per cent in bottom of the rear end of the fire-pan.

The air openings around the burner vary in size; however we find openings of 6 in. by 8 in. and 6 in. by 10 in. give very satisfactory results, and the burner should fit in the middle of the opening, so that the bottom of the burner will be about 4 in. above the floor of the fire-pan and lined so it will be perfectly straight and the oil will not strike either the floor or sides of the fire-pan.

In conclusion, it is just as important that the proper amount of air be admitted in the right way to an oil-burning locomotive as it is to coal-burning locomotive. Draft means a current of air, and as air is the only thing connected with the operation of a locomotive that costs nothing and is the blood stream and life-giving element of combustion, your committee firmly believes the judicious use and control of it is essential and of the most importance in drafting locomotives to increase their efficiency and economy in coal and oil fields.

The report was signed by J. D. Heyburn, chairman, master mechanic, St. L.-S. F.; J. C. Simino, traveling engineer, S. P.; E. R. Boa, road foreman of engines, N. Y. C.; G. W. Coyle, mechanical examiner, B. & O.; and D. Meadows, assistant division master mechanic, M. C.

Discussion

James Fahey, Nashville, Chattanooga & St. Louis, took issue with the committee on the question of down draft when the exhaust does not fill the stack, stating that a ball of waste or flag would be drawn into and down the stack under such conditions. David Meadows, Michigan Central, called attention to the vital importance of lining the nozzle and stack so that the steam will not impinge more on one side than on the other. He recommended chang-

*Abstract of report presented at the thirty-third annual convention of the Traveling Engineer's Association, Chicago, September 15-18, 1925.

ing the stack size to suit the nozzle rather than changing the nozzle to suit the stack. The good results secured with the basket bridge were explained by two representatives from the New York Central who said that, while breaking the exhaust to fill the stack, this type of bridge does not increase the back pressure in the cylinders. Another member related his experience on a road having a class of freight power which was not giving satisfactory service due to excessive back pressure. The first change made was to increase the size of the nozzle, when it developed that the locomotive would not make steam. The stack was then enlarged, with no improvement in steaming ability. The taper of the nozzle was then changed to make the steam jet fill the stack and this proved to be the solution of the difficulty.

It was brought out that the rules laid down for front end design by the Master Mechanics' Association in 1904 are now obsolete and a complete reconsideration of the various factors entering into nozzle, stack and entire front end design must be given. The impossibility of changing one element of the design without affecting the others was also emphasized. One of the members said that it was a mistake always to go to the nozzle when trouble is experienced with excessive back pressure. The setting of the valves also has an effect and the trouble may be, for example, lack of exhaust clearance.

There was considerable discussion between the advocates of large and small air openings in the grates, as affecting the efficiency of locomotive draft. One group maintained that the larger the openings, up to 45 or 50 per cent, the better the results, whereas others testified that table grates with air openings as small as 12 per cent are securing good results with certain lignite coals which burn with a fine ash, much of which passes out the stack. The advantages claimed for the table grates are the prevention of loss in firing up and the prevention of a considerable amount of stack loss when locomotives are working hard with a relatively light grade of coal in the firebox. C. C. Shaw, International-Great Northern, said that the whole question of providing draft for locomotives, particularly as relates to the grate design, is to keep the air openings through the grates adequate after the locomotive has been in operation for a considerable period of time.

Safety Section, A. R. A. reports progress

THE Safety Section of Division I, American Railway Association held its ninth annual meeting at the Hotel Statler, St. Louis, Mo., April 27, 28 and 29, 1926. During this meeting a report was made by the Committee on Statistics, of which Thomas H. Carrow, supervisor of safety, Insurance Department, Pennsylvania, is the chairman, which included a number of vital statistics which directly concern the mechanical department. Following is an abstract of the report.

Progress and possibilities in safety

The progress in accident prevention is clearly written in the yearly records of the Interstate Commerce Commission. These records can be traced in such detail as to enable us not only to put our finger on the improvement that has been effected, but more particularly to point out the additional specific action that must yet be taken to establish maximum safety.

Causes and remedies

Great emphasis must be placed upon the proposition that the solution of the accident problem consists of first, ascertaining not only the general but the specific conditions that have, and if permitted to exist, will continue to cause accidents and, second, applying not general but specific remedies.

In the following table various dates are shown because of changes or lack of uniformity in the classifications, and "All Persons" includes all other classes of persons not specified.

Railway Accidents

(I. C. C. Reports)

	Employees		Passengers		Trespassers		All persons	
Year	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1913	3,715	171,417	350	15,130	5,558	6,310	10.964	200,308
1925	1,600	119,000	175	5,624	2,644	2,928	6,766	137,435
Decrease ...	2,115	52,417	175	9,506	2,914	3,382	4,198	62,873
Per cent...	57	31	50	63	52	54	38	31

In the year 1913 10,964 persons of all classes were killed in railroad accidents of all kinds and 200,308 were injured. These figures constitute the greatest number of casualties that ever occurred in any year, and 1925 compared with 1913 shows a reduction of 32 per cent. By a singular coincidence this percentage of reduction is almost exactly the same as called for by our safety goal of 35 per cent. Employees show a reduction of 57 per cent in killed and 31 per cent in injured; passengers a 50 per cent reduction in killed and 63 per cent in injured and trespassers a 52 per cent reduction in killed and 54 per cent in injured.

These reductions are made more impressive by associating the figures with the tons carried in 1913, which amounted to 2,058,000,000 tons compared with 2,260,000,000 tons in 1924, the latest available figures. A corresponding increase has been shown in the passenger business of the railroads.

A resolution—Maintenance of Equipment department

The report concluded with sets of resolutions, one for each department. That for the mechanical department follows:

Whereas, there are 540,000 employees in the Maintenance of Equipment department of the railroads of the United States, of whom 221 were killed and 53,311 were injured in 1924, representing 15 per cent of all fatalities and 43 per cent of all injuries to employees on duty, and

Whereas, the general causes of accidents and percentage of accidents due to each general cause are as follows: Physical conditions (defective material and equipment, lack of safeguards, litter or other physical hazards) 5 per cent; human factor (violation of rules and other forms of negligence, 10 per cent, and carelessness, thoughtlessness, indifference, ignorance or physical and mental unfitness and misadventure, 85 per cent); and

Whereas, the means of preventing accidents are as follows: Physical conditions (improved design and construction, better maintenance and installation of necessary safeguards); human factor (improved training, supervision and discipline, and safety organization, education, persuasion, co-operation and first aid and medical attention); and

Whereas, injuries due to poor housekeeping, poor illumination, slipping and falling, handling material, handling and use of hand tools, particles in the eye, burns, etc., constitute the majority of the injuries to maintenance of equipment employees, which renders proper selection, safety supervision and training imperative, and

Whereas, master mechanics are responsible for the introduction of appropriate safety measures in the maintenance of equipment department,

Resolved, That the Safety Section, American Railway Association, appeals to all master mechanics and other officers in charge of maintenance of equipment to provide, through their general foremen, foremen, assistant foremen, gang leaders and other supervisory forces, full and complete safety supervision and training of maintenance of equipment employees, particularly new and inexperienced men, to the end that maximum safety may be assured and a 35 *per cent reduction in casualties* by 1930, which is the safety goal of the railroads, may be achieved.

Increased iron wheel flange thickness proposed

Greater safety, longer service and reduced maintenance cost will result from reinforcement

By F. K. Vial,
Vice-President and chief engineer, Griffen Wheel Company, Chicago

As long ago as 1912 and 1913 the American Railway Association Wheel committee called attention to the desirability of reinforcing the flange of chilled iron car wheels. Several million chilled iron wheels are in service with their flanges thicker than the A. R. A. maximum and with no standard gages for their acceptance or mounting. This condition is clearly recognized by the Wheel committee in its report of 1923, page 12, which states:

"It is understood that wheels having different tread contours and flange sizes greater than those shown in standard drawings will not be included under the class of improper repair wheels. The committee's reason for excluding the tread contour and the flange dimensions is that this subject is still open for discussion by the committee and a number of roads are using special tapers and also a special reinforced flange, which in no way affect the safety of the wheel."

Also in its recent report at Atlantic City the following reference is made:

"The standard A. R. A. gage for mounting cast iron wheels has been subjected to much criticism because of the difficulty in using it in mounting two maximum flanged wheels, or wheels where the tread wear results in a maximum flange. Difficulty is also experienced because of the inadaptability of the gage for use on reinforced wheels which are being used by a number of railroads."

The time is now opportune for reconciling the A. R. A. gages to a desired flange design which can be made standard. All the preliminary work of preparing the way for an improved standard has been accomplished. It has been shown that it is entirely possible to increase the factor of safety of worn flanges 30 per cent to 50 per cent. The American Railway Engineering Association has given its approval to the feasibility of an increased thickness of flange from a track standpoint. It is, therefore, pertinent at this time to develop the whole subject, showing the flange requirements, the present status of the relation of flange to track, the laboratory tests showing the increased strength of flange, and the service records indicating a decided improvement in the factor of safety.

Flange requirements

The chilled iron wheel was designed and introduced into the railway service of the United States when wheel loads were comparatively small. As wheel loads increased from 5,000 lb. to 30,000 lb., the plate, hub, bracket and tread sections were increased sufficiently to take care of the increased service requirements. The reliability of the flange has been such that practically no change in thickness has been made from the time of its first introduction. There is sufficient evidence, however, to demonstrate that the flange is no exception to the well established law of engineering design that to obtain a uniform factor of safety the metal must be proportioned to the stress. Table I indicates the growth in

Table I—Comparison of the growth in car capacity, wheel load and flange pressure during 50 years

Capacity of axle	Journal size, inches	Year axle recommended	Car capacity, lb.	Load on wheel, lb.	Normal flange pressure on curves, lb.
......	....	....	20,000	5,000	3,750
15,000	3¾ by 7	1873	40.000	8,250	6,200
22,000	4¼ by 8	1889	60,000	12,000	9,000
31,000	5 by 9	1896	80,000	16,500	12,375
38,000	5½ by 10	1899	100,000	20,125	15,100
50,000	6 by 11	1910	140,000	26,250	19,700
60,000	6½ by 12	1918	170,000	31,000	23,250
70,000	7 by 13	1920	200,000	35,000	26,250

car capacity, wheel load, and flange pressure during the past 50 years.

The normal pressures shown in the table are for ideal conditions. The pressures may be doubled momentarily on irregular track, which at high speed cause the car to sway back and forth, delivering impact blows of large magnitude. It is, therefore, necessary in considering a factor of safety to add a liberal amount to the figures shown for impact.

The advent of the 100,000-lb. capacity car caused the manufacturers of chilled iron wheels to proportion every part of the wheel design to meet the service required of it. The question of reinforcing the flange was brought to the attention of the Wheel committee in the years 1909 and 1910, which led to a survey by them in the year 1915 to determine the number of broken flanges in the United States in one year. Conclusions of this investigation were reported at the 1916 convention at Atlantic City, as follows:

"Failures of flanges of cast iron wheels under fair usage, other than those caused by circumferential seams, are so rare as to be almost unknown."

A railway magazine referring to the Committee's report, commented as follows:

"Rightly viewed, this committee's report is the highest possible encomium upon the chilled iron wheel."

The comments, based on the study of all the broken flanges reported in one year, are listed in Table II.

Table II—Number of broken flanges reported in one year

Weight of wheel, lb.	Year cast	Thickness of flanges at a point 3/8 in. above tread: Less than 15/16 in.	15/16 in. to 1 in.	Over 1 in. to 1-1/16 in.	Over 1-1/16 in. to 1-1/8 in.	Over 1-1/8 in. to 1-3/16 in.	Over 1-3/16 in. to 1-1/4 in.	Over 1-1/4 in.	Totals
625	1915	..	..	..	..	..	..	..	..
	1914	1	..	..	..	..	..	..	1
	1913	..	..	..	..	..	..	1	1
	1912	1	..	..	2	..	2	..	5
	1911	..	..	..	..	..	..	1	1
	1910	..	..	..	1	..	..	1	2
	1909	..	1	..	..	..	..	..	1
	Total	2	1	..	3	..	2	3	11
675	1915	..	..	..	..	..	..	..	..
	1914	..	..	..	..	..	1	..	1
	1913	..	2	1	1	..	2	..	6
	1912	..	..	1	1	2	2	..	6
	1911	..	..	1	..	..	..	..	1
	1910	..	2	..	..	..	..	..	2
	1909	..	..	3	..	..	..	..	3
	Total	..	4	6	2	2	5	..	19
725	1915	..	..	..	..	..	..	..	..
	1914	..	..	2	1	2	..	2	7
	1913	..	2	2	5	6	2	2	19
	1912	.	1	11	5	3	5	..	25
	1911	..	1	4	..	1	2	..	8
	1910	..	..	6	1	3	2	2	14
	Total	..	4	25	12	15	11	6	73

This table is extremely instructive in showing the relative strength of new and worn flanges, and also the relationship of gross load to broken flanges. Inasmuch as flange pressure bears a direct ratio to load, we would expect an increase in the number of broken flanges as car capacities increase. This is shown by the fact that there were 11 broken flanges under 30-ton cars, 19 under 40-ton cars and 73 under 50-ton cars. The relative number of cars in service of the various capacities at the time the investigation was as follows:

Car capacity	Wheel weight	Percentage of total cars in the United States	No. of broken flanges	Percentage of flange failures reported
30-ton	625 lb.	44 per cent	11	10.7 per cent
40-ton	675 lb.	29 per cent	19	18.4 per cent
50-ton	725 lb.	27 per cent	73	70.9 per cent

This clearly indicates the growing percentage of failures as car loads increase, and a further inspection of the table shows that in the 50-ton class the great preponderance of breakages occurred when the flanges were worn thin, and the practical freedom of breakage in new flanges. There were 50 broken flanges under 50-ton cars when the flange had worn to within 3/16-in. of the condemning limit. All these flanges passed the initial stages of wear without breakage. Hence, the final 3/16-in. worn from a flange is a large element in the factor of safety, and if 3/16-in. is placed on the back of the flange the full factor of safety is retained even when worn to the present condemning limit.

Table II represents 103 broken flanges in one year's service of 20,000,000 wheels running 10,000 miles, making a grand total of 200,000,000,000 wheel miles, or one broken flange for each 2,000,000,000 wheel miles, or for one wheel running 200,000 years.

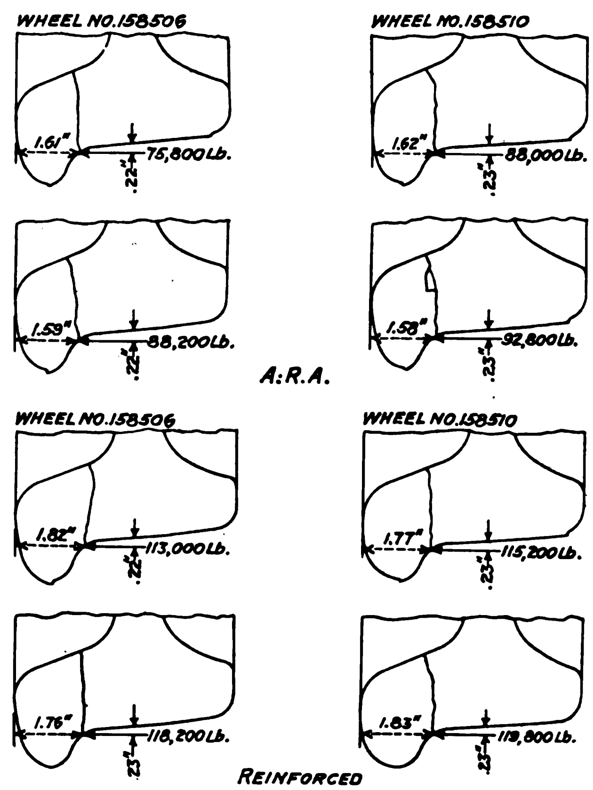


Fig. 1—Strength of new flanges with force applied 1/4 in. below tread line—The A. R. A. flange was cast on one-half of the 725-lb. wheels; a reinforced flange 3/16-in. thicker was cast on the other half of the same wheels

While this record may be considered satisfactory as compared with breakages in other parts of the car, the wheel manufacturers for the past fifteen years have done all in their power to secure an increased factor of safety by reinforcing the thickness of the flange without an increase in the cost of the wheel to the railroad.

Increased factor of safety

From a purely theoretical consideration it is certain that a decided improvement can be made in the strength of the flange and at the same time additional service be secured. It therefore seemed highly desirable to verify these conclusions and definitely determine the amount of added factor of safety which may be secured by flange reinforcement. A series of laboratory tests for this purpose was conducted at the University of Illinois.

These tests consisted of grinding the flanges of new wheels to a condition of worn flanges of various thicknesses and to make the conclusion more definite a number of wheels were cast with half the circumference having standard flange and the other half having reinforced flange. After grinding the flange to the desired contour the wheels were placed in a testing machine and the strength of the various flanges determined. The tests clearly indicate the increased strength that can be secured by a slight reinforcement at the back of the flange and thoroughly corroborated the value of flange reinforcement indicated in the service tests recorded by the M. C. B. wheel committee. Typical results are shown in Tables III to VI inclusive.

Table III—The effect of reinforcement on new flanges (See Fig. 1)

Weight of wheel	Wheel no.	Standard strength	Reinforced strength	Increase in strength
725 lb.	158,506	78,800 lb.	113,000 lb.	50 per cent
		88,200 lb.	118,200 lb.	34 per cent
725 lb.	158,510	88,000 lb.	115,200 lb.	30 per cent
		92,800 lb.	119,800 lb.	29 per cent

Average increase—35 per cent.

Table IV—Effect of reinforcing tread and flange simultaneously (See Fig. 2)

Weight of wheel	Wheel no.	Standard strength	Reinforced strength	Increase in strength
725 lb.	158,520	82,300 lb.	138,600 lb.	68 per cent
		87,100 lb.	137,700 lb.	58 per cent

Average increase—63 per cent.

Table V—Increased strength in new reinforced flange for 30-ton cars (See Fig. 3)

Weight of wheel	Wheel no.	Cracked	Final fracture
625 lb.	632,680	54,500	91,300
		64,100	69,900
650 lb.	632,452	59,300	97,800

On two of the above tests the final fracture was through the plate and tread and not through the flange.

Table VI—Effect of flange reinforcement on worn flanges (See Fig. 3)

Distance below tread at which force was applied	Flange thickness	Breaking strength	Increased strength
.62 in.	.98 in.	35,500 lb.	
.58 in.	1.14 in.	55,500 lb.	59 per cent
.37 in.	.97 in.	58,000 lb.	
.36 in.	1.15 in.	90,400 lb.	54 per cent
.49 in.	1.12 in.	66,200 lb.	

Average increase in strength—55 per cent.

The above tests indicate clearly and decisively the large factor of safety to be secured at no expense to the railroad.

In connection with the investigation of strength of flanges, an 850-lb. wheel with reinforced flange which had been worn out in service was placed in the testing machine to ascertain the flange strength in wheels for 70-ton cars. Results were obtained as shown in Table VII and Fig. 4.

Table VII—Results of tests of 850-lb. reinforced flange wheel

Wheel number	Distance of point of application of force below tread line	Ultimate strength of flange
107,348	1.26 in.	109,600 lb.
	1.19 in.	100,900 lb.
	1.09 in.	90,500 lb.
	.92 in.	115,600 lb.
	.77 in.	109,700 lb.
	.62 in.	138,500 lb.
	.41 in.-cracked	175,500 lb.
	Broke through plate	181,700 lb.

This table gives conclusive evidence of the advantage of reinforcing the flange of wheels under 70-ton cars.

The entire results are so positive and correspond so thoroughly with engineering experience in the strength of materials that the decided beneficial effect is beyond the realm of doubt. The record of the tests given in the above tables shows in detail the laboratory results.

Track conditions

Now that it has been shown how desirable it is to reinforce the flange the next question is to determine how much reinforcing can be secured under present track conditions. Perhaps no subject in connection with wheel

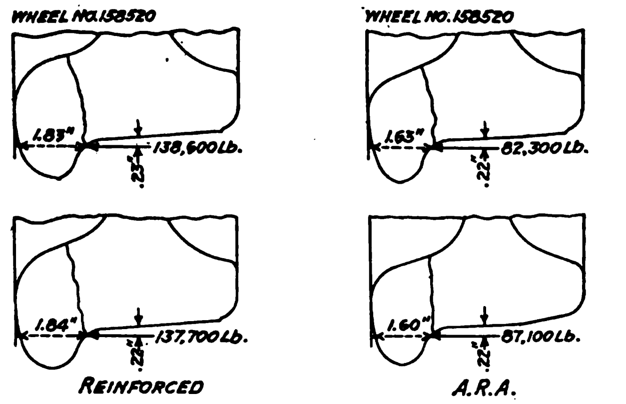


Fig. 2—Strength of new flanges with force applied ¼ in. below the tread line, with A. R. A. flange on one-half of a wheel and reinforced flange, thickened 3/16 in., and tread thickened 3/8 in. on the same wheel

design has received so careful and painstaking investigation by so large a number of experts as the subject of flange reinforcement. The history of this investigation is shown in the records of the Master Car Builders' pro-

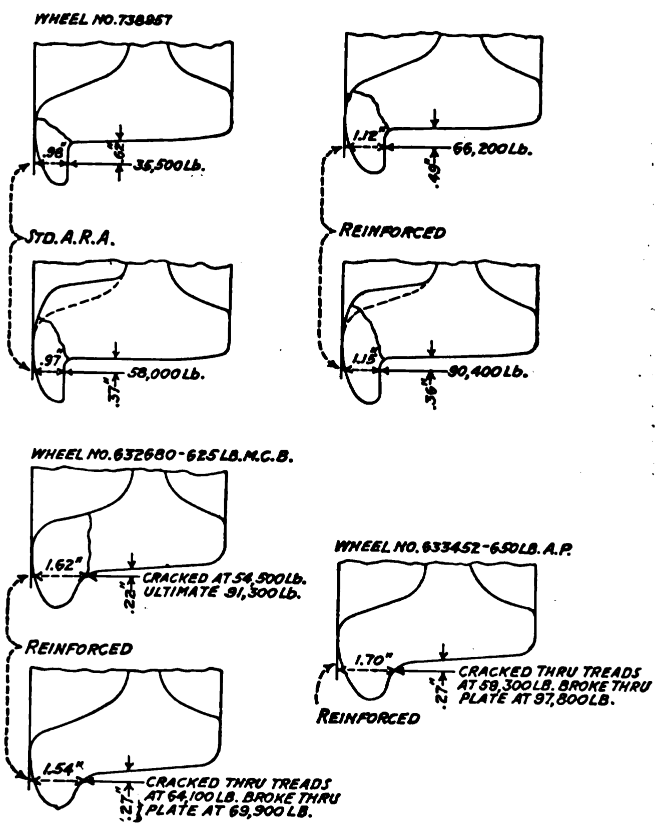


Fig. 3—Strength of worn flanges shown in the four upper sketches with force applied at various distances below the tread line—The reinforced flange is 3/16 in. thicker than the A. R. A. flange—Three lower sketches show 625-lb. and 650-lb. wheels with reinforced flanges 3/16 in. thicker than the normal A. R. A. flanges

ceedings and the proceedings of the American Railway Engineering Association.

The report of the Wheel Committee to the M. C. B. association at the 1912 convention contained the following:

"The question of increasing the thickness or the flange and mounting wheel 3/16-in. farther apart is a matter which this committee cannot pass upon or recommend. It was suggested that the Association of Manufacturers of Chilled Car Wheels refer this question to the American Railway Engineering Association as it will involve clearances in frogs, crossings, etc. If it should be found advisable after investigating this matter with the American Railway Engineering Association, the committee will report on this at some future time."

The subject was again presented by the chairman of the Wheel Committee to the M. C. B. Association at the 1913 convention, as follows:

"The wheel manufacturers have asked repeatedly to be allowed to increase the thickness of the flange 1/8 in., this 1/8 in. of metal to be placed on the back of the flange and below the tread line, or between the tread line and the center of the wheel, and your committee has not acted on this request from the fact that such increase would interfere with road conditions in regard to clearings of frogs, switches and crossings. We believe that

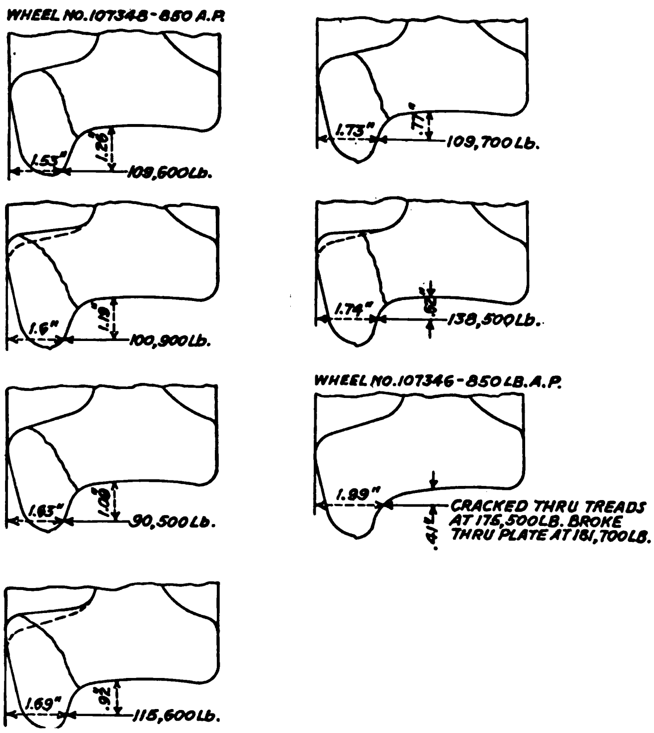


Fig. 4—Strength of worn flanges on 850-lb. wheels that had flanges 3/8 in. thicker than the A. R. A. standard, with the force applied at various distances below the tread line

with 1/8-in. more clearance in frogs, crossings and switches, the manufacturers of chilled cast iron wheels can produce a wheel that will be perfectly safe and one which will yield more economic service than any wheel on the market, and I again recommend that the matter be taken up by this Association with the American Railway Association with regard to getting an increased clearance in frogs, crossings and guard rails."

The American Railway Association refused to consider the question of increasing the clearance in frogs, crossings, etc. This, however, was not the question which the manufacturers of chilled car wheels wished to have discussed, but rather how much can the present flange be increased without interfering with present track conditions. With this understanding the American Railway Association referred the matter to the American Railway Engineering Association. A sub-committee was appointed to investigate this subject and reported as follows in the 1916 proceedings of the American Railway Engineering Association:

"The sub-committee has done some very thorough work. They came to a conclusion, but the track committee has not had time to consider it thoroughly enough to make a recommendation. The track committee sees

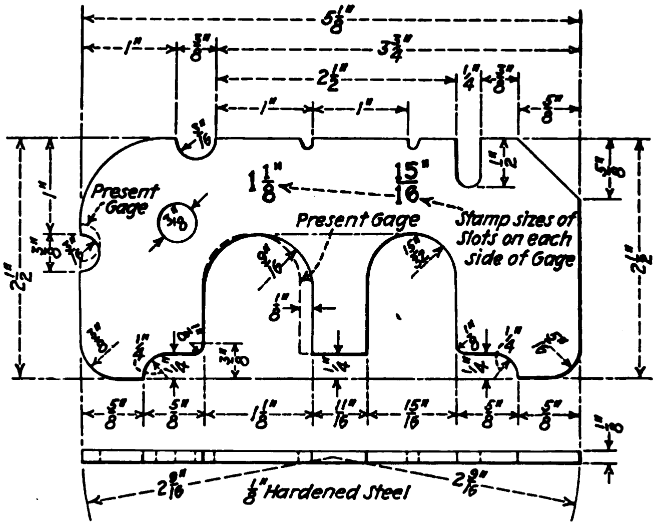


Fig. 5—Proposed wheel defect, worn coupler limit, worn journal collar and journal fillet gage

no reason why the flange of the car wheel should not be thickened as desired, and this can be done without any increase in the flangeway by closing in a little on the distance between the gage of the wheel and the gage of the track so as to allow a little less play."

The above findings of the sub-committee were made in full to the track committee, and the track committee conferred with the Master Car Builders' wheel committee which reported that nothing would be gained in the interest of safety or economy by thickening the flange as recommended. The track committee, therefore, dropped the subject. This necessitated again taking the matter up with the American Railway Association on the basis that the track committee had not reported on the subject which it was given to investigate. Another committee was appointed, which brought in its report to the American Railway Engineering Association, at its convention held in Chicago, March 18 to 22, 1918, at which time the following detailed report of the track committee was unanimously approved by the Association:

"With reference to the subject assigned to the Association by the American Railway Association and referred to the track committee relative to the contour of chilled car wheels, throat clearances for frogs, guard rails and crossings, effect of increase of thickness of wheel flanges, beg to advise that at the last meeting of the track committee held in Chicago, October 15, the chairman was directed to send you the following communication:

"'The track committee is willing to agree that the flanges can be increased as recommended by the chilled car wheel people without any serious detriment from the track standpoint, provided:

"'First: That the wheels are, in all cases, accurately mounted to 3/16-in. additional spread gage.

"'Second: That the allowable flange wear before wheels are removed be changed so that wheels will be removed when the flange is worn to within 3/16-in. of the present limit of removal.

"'Third: That more care be used in matching wheels on any given axle on account of the reduction in play and corresponding reduction in compensation from coning.

"'Fourth: That the flange width be confined to flanges of four wheeled freight car trucks.

"'Fifth: That this conclusion on the part of the track committee be not construed as an invitation to increase the axle load.'

"With the above provisions, it is believed that it will be unnecessary to make any difference in the width of flangeway of frogs and crossings or change the present method of track construction."

The above clear-cut and definite conclusion removes all doubt as to the effect on track of increasing the flange thickness approximately 3/16-in. In fact, there is absolutely no increased guard rail interference. This is because the A. R. A. rules for mounting fix a standard distance between the throat of one wheel and the back of flange of its mate wheel, regardless of the thickness of

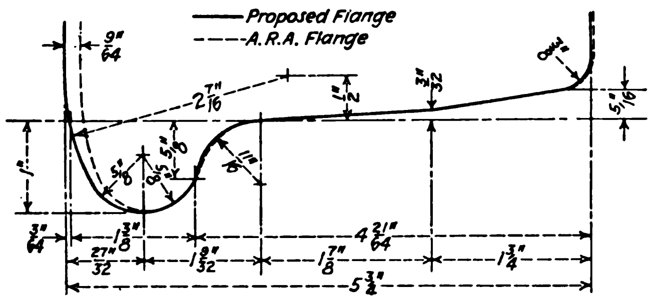


Fig. 6—Comparison of A. R. A. flange and proposed reinforced flange

flange; hence, while the throat of a wheel is crowding the rail, the back of the flange of the mate wheel is traveling at its maximum departure from its running rail, and this maximum departure is identical, regardless of the thickness of the flange, because this is the fundamental principle in mounting wheels. Therefore, it is utterly impossible for the back of the reinforced flange to wear any differently than the present standard flange.

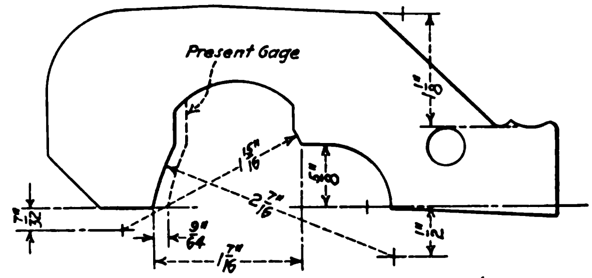
Service tests

After having received the report of the American Railway Engineering Association, the Griffin Wheel Company began the manufacture of reinforced flanges, having first secured permission from the railroad using the wheels. The popularity of their reinforced flanges has grown until at the present time there are about 4,000,000 in service having a reinforcement of approximately ⅛-in., thus demonstrating on a colossal scale that there is absolutely no guard rail interference, and no wearing at the back of the flange in any way different from that of the present standard flange. It is necessary for any flange to press against the guard rail at times if the guard rail is to serve any purpose.

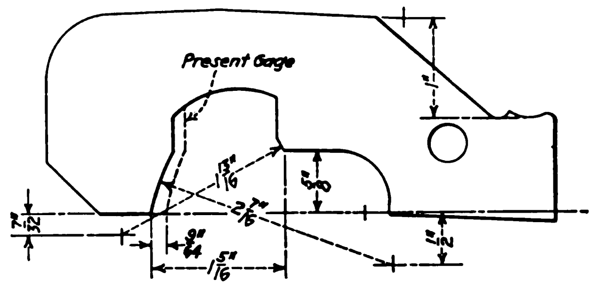
Many thousands of wheels have gone through service during the past years with a full 3/16-in. reinforcement. These can be examined in lots of a thousand or more after having given their full mileage, with no indication of having encroached upon the guard rail in any unusual manner. These results indicate that the rules of mounting in the various railroad shops are being carefully followed, for it is only in case of improper mounting that interference between flange and guard rail can occur. In fact the heavy blows on the guard rail are only possible after flanges become worn; it is the thin flange which produces guard rail interference, and not the thick flange.

Increased service

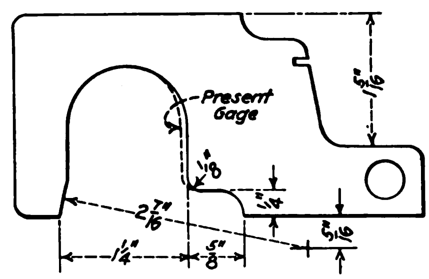
The increased factor of safety is not the only advantage of the reinforced flange. It is well known that a large amount of mileage is sacrificed by the early removal of the chilled iron wheel for various trivial causes



Proposed Gage for Maximum Thickness and Height of Flange for New Cast Iron Wheels



Proposed Gage for Minimum Thickness and Height of Flange for New Cast Iron Wheels



Proposed Limit Gage for Remounting Cast Iron Wheels

Fig. 7—Three proposed new limit gages

which are not clearly outlined in interchange rules but are left to the judgment of the inspector.

The reinforced flange will permit a revision of interchange Rule 74, whereby an increased mileage can be secured. As the rule now stands chilled iron wheels must be removed from cars of 40-ton capacity when the flange is worn ⅞-in. vertical, while all other wheels are allowed to wear 1-in. vertical before removal.

More wheels are removed for sharp flanges than for any other cause, therefore the limit of wear should be very carefully considered and the reason for the rule well established. Wheels having vertical flanges are removed on account of the tendency, when in this condition, to climb curved worn rails or split worn switch points. Chilled iron wheels under cars of 30 tons capacity and all steel wheels are allowed to remain in

service until the flange is worn 1-in. vertical. It is thus apparent that there is no relation between a wheel having a flange that is 7/8-in. vertical as far as rail climbing is concerned.

The removal of wheels for vertical flanges has no relation to the factor of safety in the flange itself, for another gage is used to remove wheels that reach a maximum of 15/16-in. thick under 30-ton cars and 1-in. thick under cars of 40 and 50-ton capacities. However,

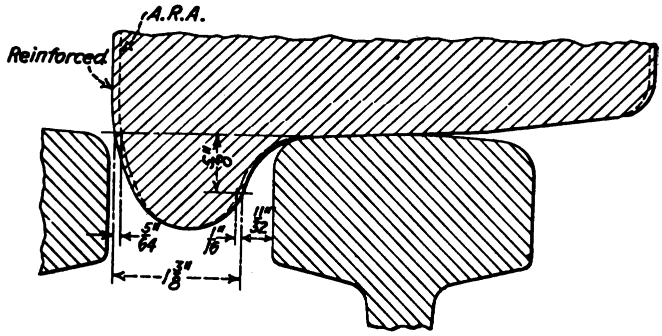


Fig. 8—Composite showing the relation of the A. R. A. and the reinforced flange to main and guard rails

for some reason or other a discrimination was made when the 40 and 50-ton cars came into existence whereby wheels for these capacities were not allowed to remain in service until worn to the same extent that is allowed wheels of lighter capacities. Evidently the factor of safety in a worn flange had something to do with the formation of the rule. This being the case, the proposed reinforcement removes all the doubt regarding the factor of safety, and instead of allowing the flange under 40 and 50-ton cars to remain until worn to 1-in. thick, they may be removed when reaching 1 1/8-in. thickness and still permit of wearing 1-in. vertical.

The A. R. A. Wheel committee's report for 1926 illustrates how many flanges are condemned on account of improper application of the gage to treads which are worn hollow. This is a very important item in connection with increased service. In most instances 20 per cent more wearing value of the flange and tread could be secured if Rule 74 was revised as suggested, in which case it would read:

Wheels with flanges having a flat, vertical surface extending 1 in. or more from the tread—for flanges of chilled iron 1 1/8 in. thick or less, for steel wheel flanges 15/16 in. or less, etc.

The wheel defect gage will require modification to agree with this rule by the elimination of the 7/8-in. gage for vertical flanges and increasing the gage for thin flanges from 1-in. to 1 1/8-in. as shown in Fig. 5.

Revision of flange contour

In choosing the amount of increase to which there can be no objection from any source, and also in fixing dimensions which eliminate all small fractions from the ruling dimensions and remembering that the usual tolerance of 1/16-in. above normal will be retained, it has been decided that an increase of 9/64-in. will fulfill all requirements. This increase is 3/64-in. less than agreed to by the track committee which will take care of the variation in casting. The flange thickness as proposed above becomes: Maximum, 1 7/16-in; normal, 1 3/8-in.; minimum, 1 5/16-in. Fig. 6 shows all the dimensions of the proposed flange.

Maximum and minimum flange gages for the proposed flange are shown in Fig. 7. They are simply 9/64-in. larger than the present standard, or in other words, the present maximum becomes practically the proposed minimum.

Limit gage for remounting

Fig. 7 also shows a proposed revision in the limit gage for remounting chilled iron wheels, whereby the minimum thickness for second hand wheels is 1-in. for all capacities, thereby eliminating the remounting gage for wheels under 30-ton cars. This will allow 1/16-in. more wearing value before second-hand wheels can be condemned. The object should always be to conserve all good material for more service. A campaign along these lines can easily secure 20 to 40 per cent more mileage than is now obtained from chilled iron wheels, at the same time provide a decided increase in the factor of safety.

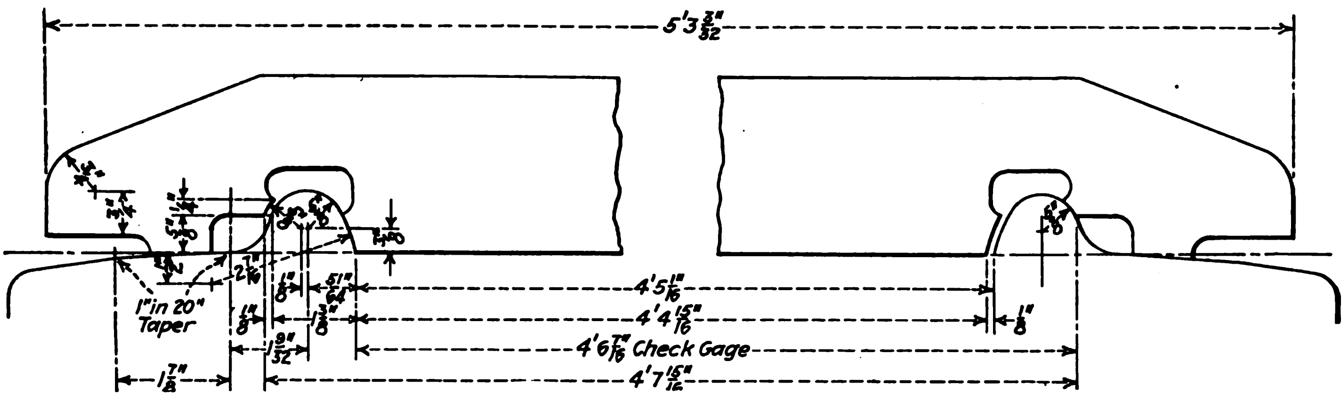


Fig. 9—Wheel mounting gage

Mounting gage

In order to remove the 1/64-in. from the mounting gage dimensions, the check gage distance, which is the most important of all dimensions in mounting, should be made 4 ft. 6 7/16 in. The code of rules governing interchange still contains a cut showing that for wheels cast prior to 1907 the check gage distance must not be more than 4 ft. 6 3/4 in. This indicates that the check gage distance has been reduced 19/64-in. since 1907, hence 1/64-in. more or less at the present time has no appreciable effect on the relation of wheels to track. Using a check gage dimension of 4 ft. 6 7/16 in. the mounting dimensions become:

	Throat to throat	Back to back
Maximum	4 ft. 7-7/8 in.	4 ft. 5 in.
Normal	4 ft. 7-13/16 in.	4 ft. 5 1/16 in.
Minimum	4 ft. 7-3/4 in.	4 ft. 5 1/8 in.

In arriving at definite conclusions, the following facts must be taken into consideration.

1—Wheel loads are now five times greater than they were when the contour of the flange was first standardized.

2—Records everywhere indicate the correctness of technical deduction that the stress in the flange increases in a direct ratio as the wheel load increases.

3—Three-sixteenths of an inch of metal added to the back of the flange will increase the strength of worn flanges 50 per cent.

4—The A. R. A. investigation reported that thickening of the flange 3/16-in. will not interfere with present track clearances.

5—Millions of wheels in service with reinforced flanges prove conclusively that there is no track interference on acount of flange thickness.

6—A 50 per cent increase in strength of worn flanges can be secured without additional cost to the railroads.

7—An additional mileage in heavy service of 20 per cent to 30 per cent can be secured with a corresponding reduction in shop costs.

The fact that the recommended flange will result in a decided improvement in the chilled iron wheel, in economy and safety without expense to the railroads, is a sufficient reason for its universal adoption. There is no greater service that can be given the railroads of America in connection with improvement in the chilled iron wheel than immediately to standardize the reinforced flange.

Maintenance of passenger car brakes*

By W. D. Herndon

Air brake foreman, Jacksonville Terminal Company, Jacksonville Fla.

When passenger cars are shopped for air brakes, the triple or control valves should be removed from the car and taken to the air room where they are cleaned on a bench provided for that purpose. This bench should not be used for any other work. The valve should be dismantled and thoroughly cleaned with gasoline, all ports and passages blown out with compressed air and all parts thoroughly inspected. All defective gaskets should be scrapped. Emergency rubber seats should be removed whether defective or not. After the valves have been cleaned, they should be lubricated with pure graphite. No oil should be used on triples or control valves. A good grade of rags should be used instead of waste.

After the triple or control valves are cleaned and assembled, they should be placed on the standard test rack and tested according to the standard code of instructions; soap suds should be used during this test. Valves that do not pass the required test must be repaired before being placed in service. Train pipe strainers should be cleaned at the same time as the triple or control valve and also the air and signal hose given a soap suds test, and any porous hose removed and sliced with a knife.

Safety and high speed valves must be cleaned, tested and adjusted. The water system governor and reducing valves must be cleaned and tested, the governors set to open at 60 lb. and the reducing valves set to maintain 18 lb. pressure in the water system. The signal line and discharge valves must be tested for leaks and all leaks found must be repaired before the car is released for service.

The cylinders must be thoroughly cleaned and lubricated with a good grade of brake cylinder lubricant, being careful not to use too much. The slack adjuster cylinders should be given the same attention as the brake cylinder and the brakes properly adjusted to 7-in. piston travel. Foundation brake gear should be carefully inspected for foul levers, worn key bolts, etc. Dirt collector caps should be removed and the dirt collectors blown out.

After all this work has been done, the car should be tested with a single car testing device and pass all tests before the car is released for service. This single car testing device should be used on all cars before being released from the repair tracks, whether they were sent there for air brake repairs or not, and if they do not pass the test, they should be carded for repairs, regardless of the dates on the car.

A very important test with the single car testing device is to see if the brakes will apply with a 10-lb. reduction when the valve is in position No. 4. In a great many cases the brakes will not apply in this position, owing to combined leakage through cylinder packing and leakage grooves. This happens mostly with the old PM equipment and should not be mistaken for triple valve defects. This trouble, however, is not likely to happen with the quick service triples.

Defects in UC valves

We have experienced a lot of trouble with the older types of emergency pistons bending and binding the rings in the ring groove, and in a great many cases causing the pistons to become inoperative. On one occasion we had a UC valve giving trouble on account of going in emergency on a service application. When this valve was placed on the test rack, I found that when a service application of 6 or 7 lb. was made, the valve would go to emergency, but did not vent brake pipe pressure to the atmosphere. When the valve was dismantled, I found the emergency piston bent and stuck in emergency position. While this valve was being tested, we did not get any air in the quick action and quick action closing chambers.

The reason for this valve giving an emergency application on this car was that when the brakes were applied, the release slide valve moved to application position and connected the bottom of the high pressure valve with the atmosphere through the emergency slide valve. This connected the back of the intercepting valve momentarily to the atmosphere. The service reservoir pressure, being present on the face of the intercepting valve, caused the intercepting valve to open and pass service reservoir pressure to the brake cylinder and, as the brake cylinder pressure was present on the spring side of the intercepting valve, the spring closed the intercepting valve. This in turn caused emergency reservoir pressure to flow to the brake cylinder, giving a high brake cylinder pressure.

Emergency piston rings

If I remember correctly, the Westinghouse Air Brake Company does not give any test for emergency piston rings, and I have found considerable trouble with worn emergency piston rings. I find that a badly worn emergency piston ring will cause a blow at the emergency slide valve exhaust port when the valve *A* on the test rack is returned to lap position after making a reduction

*Paper presented at the July 16, 1926, meeting of the Southeastern Air Brake Club, Atlanta, Ga.

in brake pipe pressure. This is due to the ring leaking and the piston will not return back to its former position. This caused the quick action chamber pressure to be reduced. That in turn causes the brake pipe air to be reduced by the amount of air that the packing ring is leaking.

Blow at emergency exhaust port

Not long ago I had a UC valve cut out on the road because the emergency rubber seated valve would not seat after an emergency application. This valve was placed on the test rack and I found that it would not seat after an emergency application, and I had a blow at the emergency port when we returned the valve *A* to release position. On examination, I found that brake cylinder pressure was flowing from the emergency slide valve chamber down underneath the quick action piston, raising the quick-action piston and holding the emergency rubber seated valve from its seat, causing train line pressure to escape to the atmosphere. This was due to a plug being loose in the side of the emergency slide valve.

I am mentioning these facts to impress upon your mind that a man, to become a successful test rack operator, must first understand the operation of the valve.

Other trouble we have with the UC valve is the protection valve getting grit in it and failing to return to its atmospheric seat after an emergency application. The best remedy I know of is not to use any lubricant on this valve at all; although I have found that pure graphite does not do any harm when applied properly. I should also like to mention that I find about 50 per cent of the UC valves in service when tested fail to take the protection valve test on the test rack.

We use a portable test truck for train yard testing; you can use this truck on any length of passenger train up to 20 cars. When testing trains in a train yard any cars that will not pass the test with the portable test truck are sent to the repair track for repairs. We also use this test truck on cars that are reported as defective before they are sent to the repair track.

Testing steam hose couplings

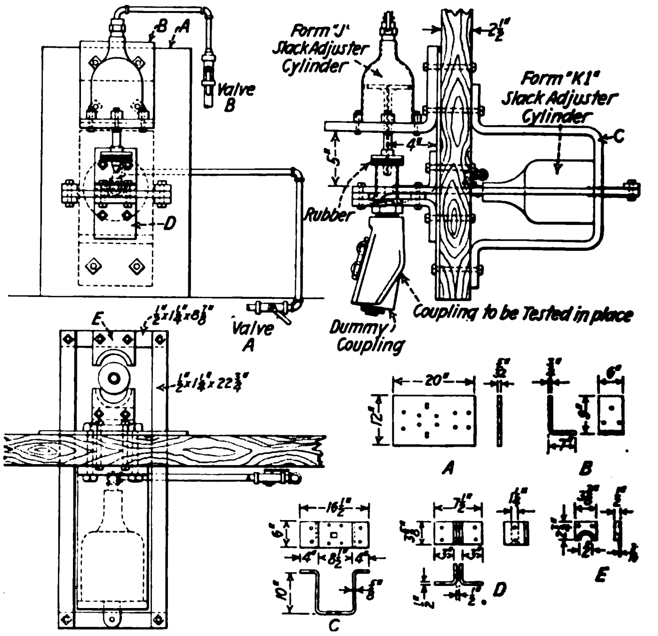
By Thomas Birch

Air brake foreman, C. M. & St. P., Milwaukee, Wis.

A CLOSE analysis of the situation emphasizes the real economy of testing steam hose couplings before remounting in new hose. There is one defect in particular that is almost impossible to detect and, in a large number of cases, is not noticed until a complete failure takes place. This is a fracture on the under side of the nipple where it tightens up in the coupler head, undoubtedly caused by failing to chain up the hose in switching movements and thereby permitting the coupler to strike the rail when making cross-over movements. The number of these defects is surprisingly large, averaging about eight per cent of all the hose handled. This fracture is not readily evident when submitting the hose to steam pressure because the heated metal expands and temporarily closes the crack, but if air pressure was used for testing purposes, the leak would be instantly obvious to the observer.

With this knowledge we designed a device as shown in the illustration which, since its installation, has proved very efficient and has disclosed many defects that would otherwise have re-entered actual service. Using an air pressure of about 90 lb., we are also able to obtain a fairly accurate knowledge of the condition of the gasket and the locking features of the coupler.

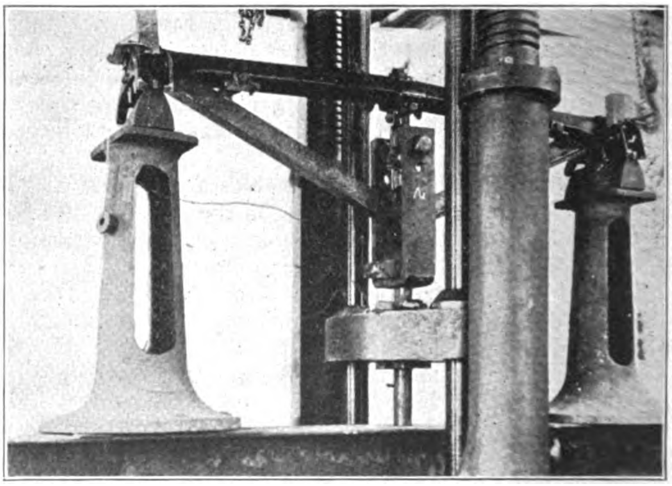
The drawing is in such detail as to make the construction and the operation of the device easily understood. A dummy coupling is attached to the coupling that is to be tested, and the nipple that is already in place in the coupling is set on the lower half of clamp *E*. Valve *A* is then opened permitting air to flow to the *K-1* cylinder, this causes the upper half of clamp *E* to move down and securely clamp the coupler head in place. Valve *B* is then opened permitting air to flow to cylinder *J*. This forces outward the piston on the end of which is a sub-



Steam hose coupling testing device which discloses many defects

stantial rubber gasket that seals the end of the nipple. There is a small hole drilled through the entire length of the piston through which pressure flows into the coupling simultaneously with the sealing of the nipple.

A liberal use of soapsuds is then resorted to in looking for defects.



Bending and deflection tests of brake beams on a 200,000 lb. Riehle testing machine at Purdue University

Accident prevention at Enola steel car shop

Workmen must not be coerced into but sold to the idea of safety first—Advertising principles used

ON page 97 in the February, 1926, issue of the *Railway Mechanical Engineer* appeared an article descriptive of the shop layout, organization and methods of rebuilding steel cars at the Pennsylvania System Enola steel car shop, located about five miles from Harrisburg, Pa. The output averages consistently 36 cars per day.

There are many industrial hazards to be found in a steel car repair shop which are conducive to accidents if the men are not properly trained, both mentally and physically, to guard against them.

Those in charge of the "safety first" movement at Enola are aware of these conditions and naturally realize the increased responsibility in trying to reduce accidents to a minimum, but have not lost sight of the fact that the workman is responsible for accidents in most cases and he, therefore, is the one that must have the supervisor's almost constant attention. He must be taught to accept the conditions as they exist and train himself to a realization of the apparent danger and use the necessary precaution to master danger or eventually be dropped from the service.

Conditions faced at the opening of the shop

At the opening of the Enola shop there were about 250 men available who had previous experience in repairing cars by the old method. Their experience helped insofar as getting out the work was concerned, but by transferring these men to strange locations and conditions, together with a new system of doing the work, it added to their difficulty in the mastery of danger.

To obtain the desired production of 36 cars a day, it was necessary to employ about 620 additional men who with a few exceptions, were inexperienced at any kind of skilled labor. Employing and breaking in such a large number of men in a short period of time was more difficult than the installation of 620 machines for the reason that machines can have safeguards applied as soon as installed. With the human machine it is quite different. The men can be furnished with goggles and acquainted with safety rules, but unless they see the importance of wearing goggles and obeying the rules, they will not be safeguarded.

The best way to guard a workman is to sell him the safety idea which generally requires a great deal of time, effort and determination on the part of the supervision, as no man is sold to the safety idea until he realizes the importance of preserving life, limb and property.

It required five months to increase the force to 870 men during which time there, naturally, was a very large turnover of labor which did not minimize the accident hazard.

Method of selecting men for employment

If the applicant for employment appears physically capable, he is given a general outline of the work he will be expected to perform. After inquiring as to his ability, previous experience and where acquired, he is questioned as to what he knows about "safety first" and if he

Left—One of the effective "safety first" signs painted on the wall and the safety honor roll near the toilet door; Right—The shop's slogan painted over one of the office windows

believes in it, the number of times he has been injured or has injured others during the past three years. He is also questioned as to what action he would take if confronted with certain dangerous conditions.

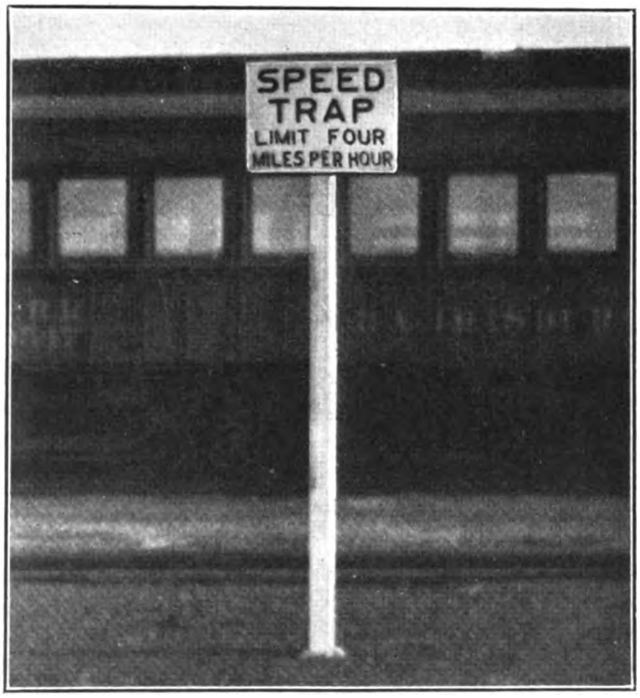
If his answers are satisfactory, he is accepted and is requested to help put over a 100 per cent no accident record each month and at the same time is given to understand that in order to remain employed he must divorce himself from carelessness. He is instructed to report for duty with gloves and heavy-soled shoes and told why in detail. Experience is a great teacher, but no workman should be allowed to experience a costly accident before learning details. By taking care of details, the job will take care of itself.

Means employed for training men

When the new man reports for work, he is first given an instruction book for the guidance and protection of new and inexperienced employees. He is given goggles, if the nature of his work requires them, for which he acknowledges receipt in writing. He is then introduced to his gang foreman who gives him instructions in a general way regarding cleanliness and order in his work and about the premises, gives him an outline of the nature of his work, acquaints him with the details of his job, and instructs him how to avoid accidents.

The new workman is then introduced to the men with whom he will be assigned to work. The gang foreman establishes as friendly relations between them as possible and gives the new man more than ordinary supervision and attention the first few weeks, in order to observe how he is progressing and give him necessary instructions. After that he is given the same supervision as the other workmen.

When new men are employed in numbers, they are placed under a competent instructor for a reasonable length of time. As all men are not adapted for the same job it is necessary to drop some of them. Teaching a man to perform the actual labor is a small matter compared with getting the safety idea into his mind.



An effective method of preventing the workmen from running from the work train across the tracks to the shop

Accident record

From July 23, to December 31, 1923, an average of 31 lost time accidents a month occurred, 43 being the highest and 17 the lowest. From January 1 to June 30, 1924, inclusive, an average of 58 lost time accidents a month occurred, 79 being the highest and 42 the lowest.

Up to this time the supervision and a few workmen who were serving as safety committeemen were depended on to preach and practice safety first. It was then decided, beginning July 1, 1924, to appoint one workman from each position on each trick to serve as a safety committeeman for a period of one month. This increased the number of committeemen to 34. The foreman holds a two-hour monthly meeting with these men for which time they receive compensation. Their duties are to preach and practice safety first and report all dangerous conditions and practices which come to their notice. They are also to do all in their power to convert the workmen to the "safety first" idea. By having 34 workmen on a committee of this kind and changing them monthly, eventually the foreman has an opportunity to consider safety problems for at least two hours with every man in the shop.

These "safety first" bulletins are sure to be read

The first thing considered was whether the most careful or most careless man in each position should be appointed on the committee. It was decided on a 50-50 basis. By so doing there were 17 careful workmen to help sell the safety idea to the 17 who were more or less thoughtless or negligent.

At these meetings, the accidents of the previous month are reviewed and thoroughly discussed. Suggestions are invited and when any are made, the employees who make them, in company with the foreman, investigate them directly after the meeting has adjourned.

Where there is any merit, action is immediately taken and the men given proper credit. Prompt action in such cases may not only prevent an accident the following day, but cause the men to feel that their suggestions were of importance.

It was considered a good idea to have one or two of the men read a short article from a magazine on safety even if material had to be furnished for them. This creates the impression among the other committeemen that some are taking more interest than others and gives them a desire for more knowledge about safety. Another successful plan was to praise the work of the previous committee and give them credit for everything they had

accomplished during their service as committeemen.

These meetings give the foreman a splendid opportunity to present other matters pertaining to the shop and company policies. They also tend to increase the spirit of co-operation and create a better understanding between the supervisors and workmen.

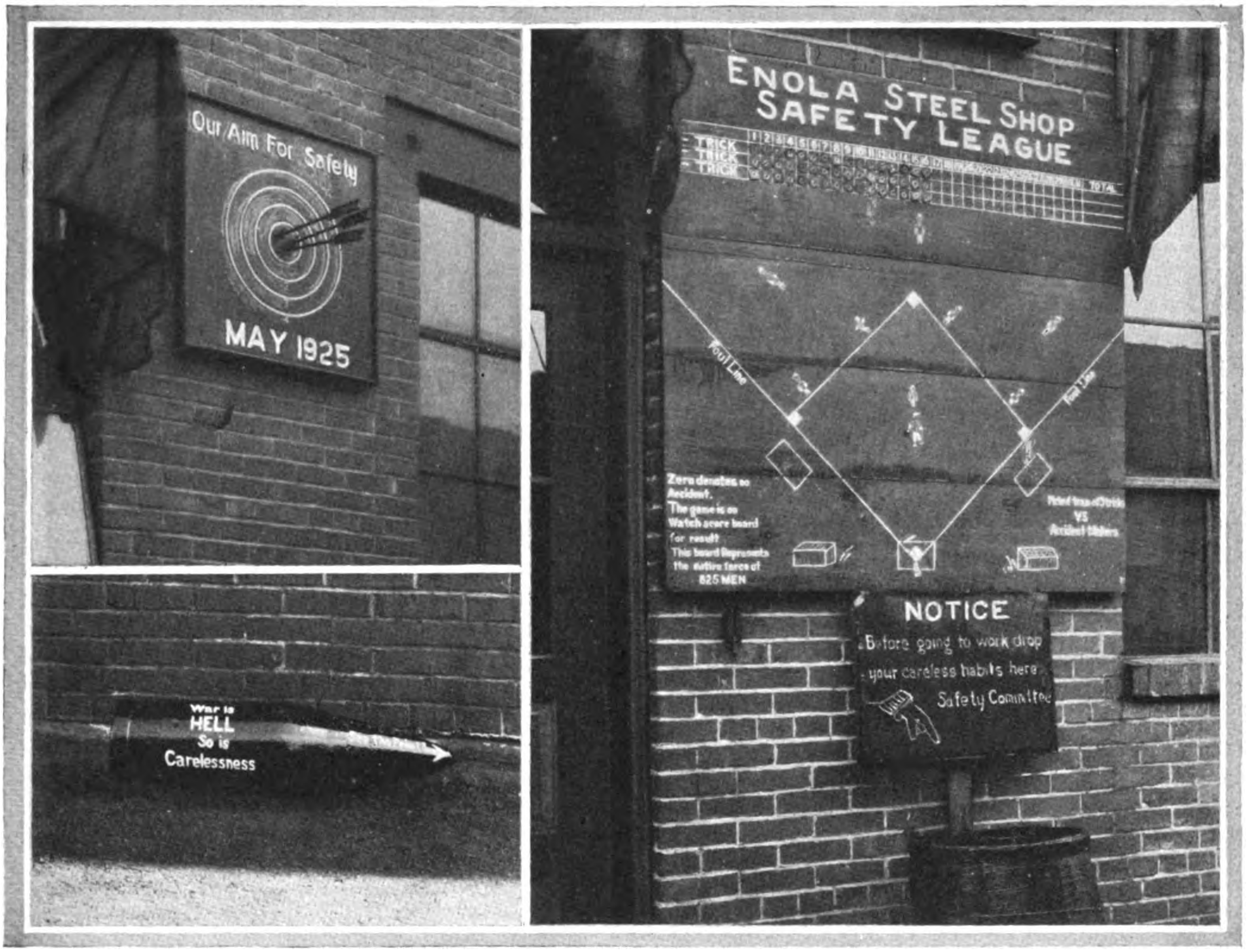
For the first ten months that this committee functioned, there was a total of 393 lost time accidents or an average of 39.3 per month compared with the previous ten months when there was a total of 477 lost time accidents, or an average of 47.7 per month. This shows a decrease of 17.6 per cent for which the members of the committee were given due credit.

During April, 1925, there were 12 lost time accidents as compared with 51 for the corresponding month in prior when there were a total of 307. This made a reduction of 291 lost time accidents, or 94.8 per cent.

The following statement shows the accidents which occurred at the Enola steel car shop during 1925:

January	34
February	31
March	24
April	12
May	0
June	1
July	1
August	2
September	1
October	5
November	1
December	7
	119

One day absent from duty constitutes a lost time accident.



Lower left—A grim relic of the war tied up to the hazards of carelessness; Upper left—All three tricks hit the bull's eye for the month of May; Right—The popular game of baseball and an empty barrel used to stimulate interest in safety

1924. It was now felt that "Old man accident" was about winded and all that was necessary was to go after him in May and give him a knock-out blow, which was done by having a 100 per cent no-lost time accident month.

During this month, with no lost time accidents, 127,860 man-hours were worked, 750 cars repaired, an average of 825 men employed, 1,340,250 rivets driven, 6,886,000 lb. of scrap reclaimed, 7,642,800 lb. of new material applied to cars and 2,288,000 lb. of steel removed, straightened and reapplied.

From May 1 to Dec. 31, 1925, there were a total of 16 lost time accidents as compared with the eight months

Some of the methods employed during May, 1925, and since to sell the safety idea

After the fine showing made during the month of May, all supervisors, safety committeemen and the majority of the workmen tackled the job with renewed energy and enthusiasm. The following slogan was adopted: "Less accidents or less employees."

In order to make the slogan effective, it was necessary to dismiss five employees from the service because of continual carelessness. It later developed that one of these employees who was working at the shop on the night shift was cultivating, during the day, a 30-acre

farm on which he lived. This explained the cause of his numerous accidents.

The successful business man knows the true value of advertising. In selling the safety idea, advertising was one of the chief factors. Safety signs were placed about the shop layout at every feasible point which would be seen by the workmen. The signs which were permanent were, at intervals, moved from one place to another so that all the men would have an opportunity to read them. A few of these signs are shown in the accompanying illustrations.

The following notice was painted on the wall of the office in such a location that the attention of all persons entering was immediately attracted to it.

TO MEN SEEKING EMPLOYMENT

UNLESS YOU ARE WILLING TO BE CAREFUL TO AVOID INJURY TO YOURSELF AND FELLOW WORKMEN, DO NOT ASK FOR EMPLOYMENT. WE DO NOT WANT CARELESS MEN IN OUR EMPLOY.

Another notice on the wall of the office directly over the first aid cabinet reads as follows:

ALL THOUGHTFUL EMPLOYEES WILL AND OTHERS MUST REPORT PROMPTLY TO THIS OFFICE AND RECEIVE FIRST AID ATTENTION, REGARDLESS OF HOW SLIGHT THE INJURY MAY BE CONSIDERED. WE MAY PREVENT, BUT WE CANNOT CURE LOCK-JAW OR BLOOD POISONING.

The following permanent notices were painted on tin in large letters and displayed about the shop in conspicuous places.

CARELESS EMPLOYEES ARE DANGEROUS EMPLOYEES, DANGEROUS EMPLOYEES ARE UNDESIRABLE EMPLOYEES, UNDESIRABLE EMPLOYEES WILL NOT BE ALLOWED TO REMAIN IN THE SERVICE. A WORD TO THE WISE IS SUFFICIENT.

Every man in the shops read the following notice:

The man who is careless and knows that he is careless is a fool—Avoid him.

The man who is careless and does not know that he is careless is simple—Teach him.

The man who is careful and does not know that he is careful is asleep—Arouse him.

The man who is careful and knows that he is careful is a wise man—Follow him.

The sentiment expressed in this notice is as it should be:

THE CARELESS MAN CAN RECEIVE FIRST AID IN THE OFFICE, BUT NO SYMPATHY WHATEVER.

Another notice, which appears over the tool room window tells the object of "safety first" in a nut-shell.

SAFETY FIRST
MEANS FEWER
WIDOWS, ORPHANS AND CRIPPLES
AND LESS . .
DESTITUTION AND MISERY

The following slogan is painted on the bridge of the 15-ton crane.

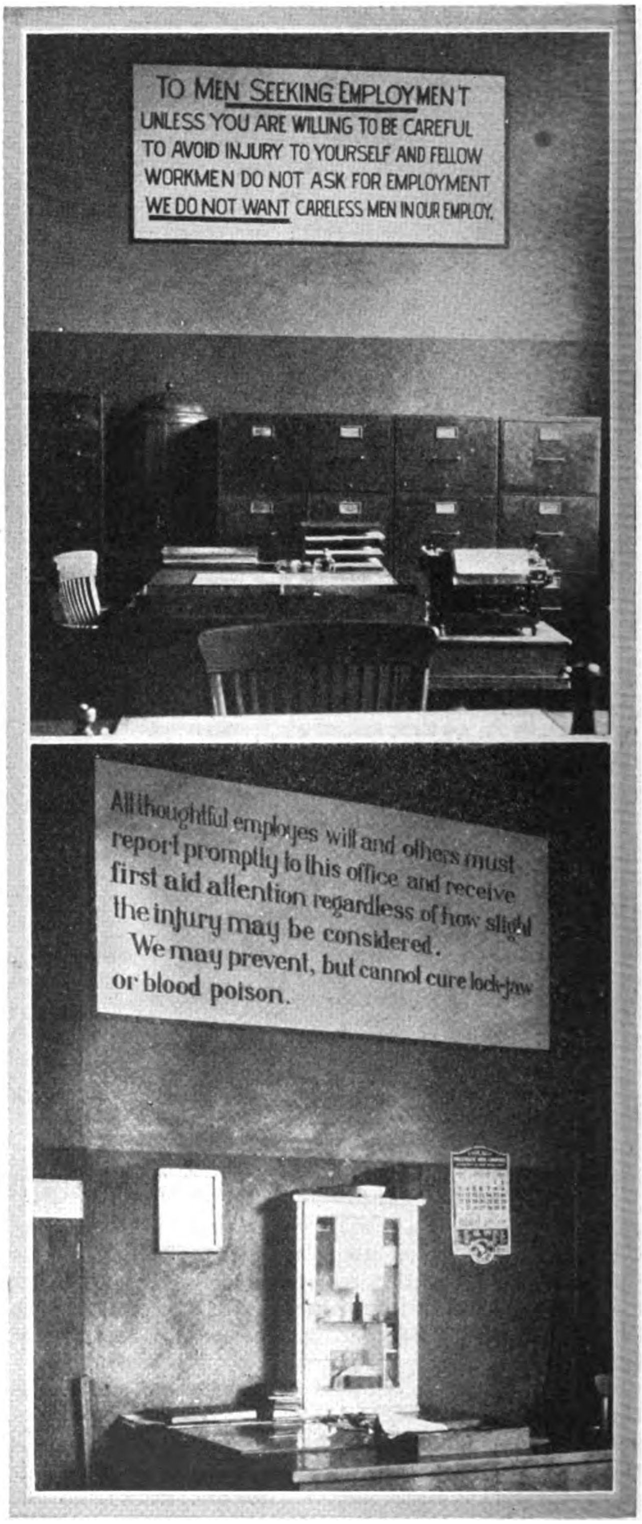
SAFETY IS THE DEVELOPMENT OF A MENTAL ATTITUDE. CARELESSNESS IS THE SAME THING.

Six 9-in. by 12-in. posters taken from the National Safety News are displayed on bulletin boards back of each drinking fountain. Twenty posters of the same size are placed directly over the urinals in the lavatory. One large and four small posters are placed in each of the eight coaches of the workmen's train. These posters are changed from time to time.

A large covered mirror was placed in the locker room with the following wording on the cover which hangs over the front of the mirror

UNDER THIS COVER YOU WILL FIND THE MAN WHO IS MOST LIKELY TO INJURE YOU, NOT INTENTIONAL, BUT THROUGH BEING THOUGHTLESS OR CARELESS, RAISE THE COVER AND LOOK HIM OVER.

A safety honor roll has been placed in the shop in an attractive cabinet with the following introduction, signed by the foreman:



These two signs are located in the foreman's office so that they must be seen by those seeking employment

THE FOLLOWING MEN HAVE WORKED DURING THE YEAR 1924 AT THE ENOLA STEEL CAR SHOP WITHOUT CAUSING A LOST TIME ACCIDENT TO THEMSELVES, OR OTHERS. THIS IS A VERY CREDITABLE SHOWING AND THE MEN ARE HEREBY COMMENDED.

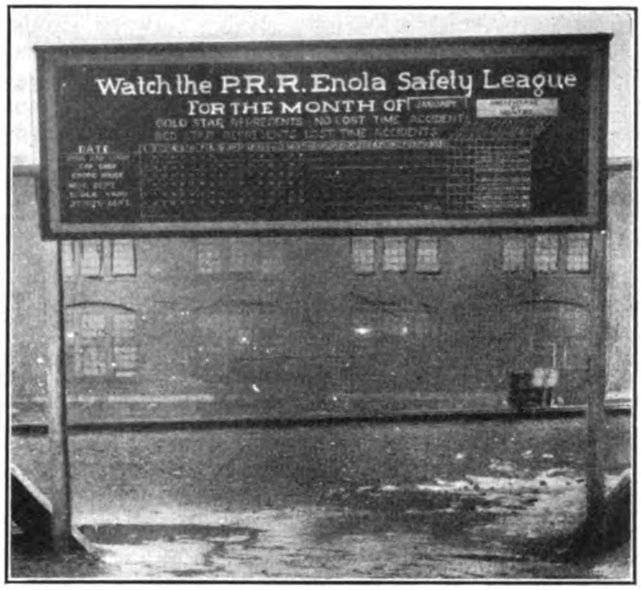
There were a total of 477 names shown on this roll for 1924, and 791 for 1925.

A 30-in. by 30-in. banner is carried about the shop at different times on which is painted safety slogans or other information regarding the "safety first" drive that is being tried to be put across to the men.

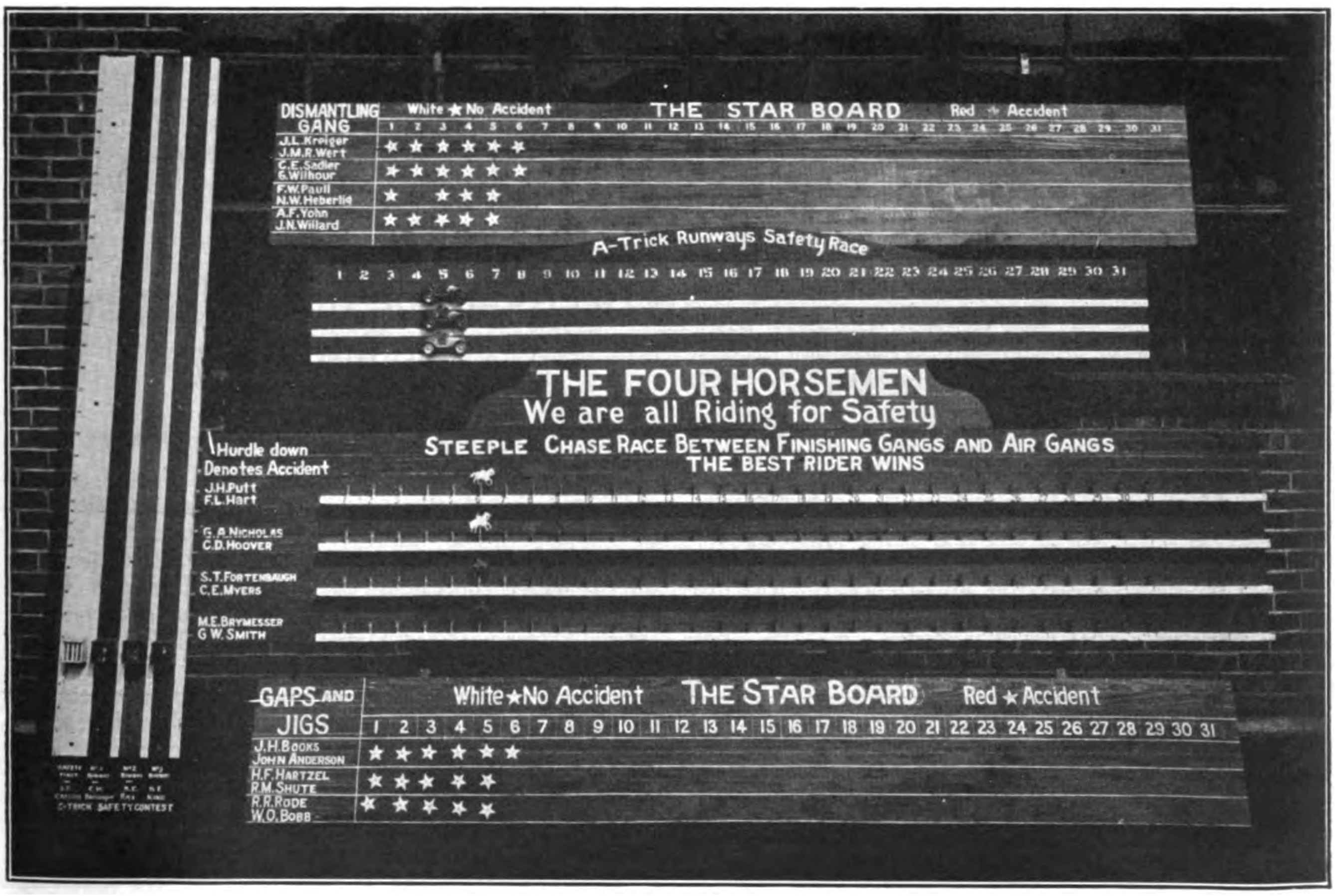
A "safety first" contest board located in the reclamation yard

In the morning the men detrain from the workmen's train about 250 ft. from the shop. Employees riding this train must cross three tracks and a 6-in. air line extending about 10-in. above the ground level. To break up the dangerous practice of employees running from the train to the shop, speed trap signs were erected readings: "Speed trap, limit four miles per hour." The novelty of this sign appealed to the workmen.

A barrel placed on the outside of the office, above which the following notice was placed, "Before going to work, deposit all careless habits here. By orders of Safety Committee." Every employee must pass this barrel at least once each day. It is believed that this stunt prevented a barrel of trouble.



This sign is located at the main entrance to the shop enclosure



A group of the various star and race boards used to arouse interest in the safety movement

An 8-in. high explosive shell, 28 in. long was found in the scrap pile. It was painted and lettered as follows: "War is hell. So is carelessness. See the point?" This was located on the ground outside the office. To some this particular bit of advertising seemed insignificant, but in the words of the foreman "It helped to pierce the armor of some of our thickskinned, hard-boiled, careless employees."

In order to start a friendly rivalry between gangs, such devices as automobile, hurdle and elevator races, workmen climbing ladders, star boards, etc., were adopted. These devices showed the progress of the different gangs and helped stimulate interest in the safety movement.

To show progress by tricks, use was made of a bull's eye painted on a board with one arrow for each trick. The location of the arrows in the bull's eye showed the monthly results.

The object in view in adopting the above mentioned methods was to keep the safety idea constantly in the minds of the workmen. It was believed that the best results could be obtained by starting with a few and adding something new from time to time to stimulate interest.

Keeping in touch with careless or indifferent employees

The following notice, signed by the foreman, was posted on May 1, 1925.

> Any employee who loses time hereafter on account of an accident will be called on at his home by a company physician and a representative of this shop the first three days after he starts to lose time.

From May 6 to December 31, 1925, the foreman or one of his assistants, accompanied by a company physician when necessary, called at the homes of 62 employees who had received minor injuries and failed to report on their following tour of duty or who failed to report an accident at the time it occurred and reported off duty the following day by telephone or through another employee.

Upon investigation it developed that the injuries of four of these employees were of such a nature that it was necessary for them to remain off duty one or more days. In several cases where sprains were reported, the diagnosis of the company physician proved them to be lumbago. In other instances it was learned they were off duty on account of business or illness of one of their family.

Where employees had remained from duty unnecessarily on account of a slight injury, they were induced to return to the shop and resume duty at their regular occupations. While this method is still in force, it is seldom that it must be resorted to.

About wearing goggles

A great deal of difficulty was experienced in getting some of the men to see the importance of wearing goggles when their work was of such a nature as to require them. Among other things, they were subjected to ridicule by posting poetry such as the following:

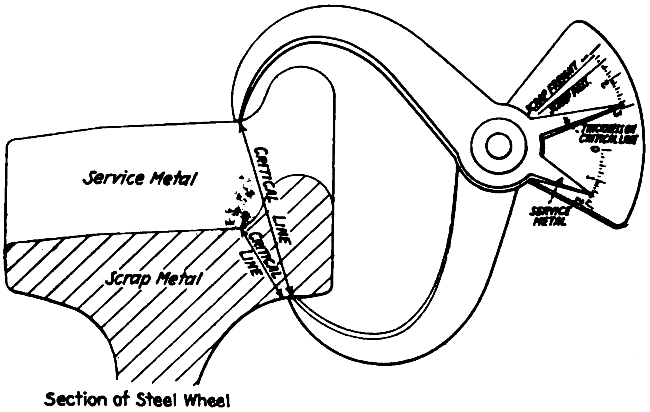
Ned Nearly

Ned Nearly was very careful, to this you'll all agree,
He always wore his goggles, but not where they should be.
He wore them on his forehead, he wore them on his clothes,
But no one can remember, that he wore them on his nose.
One day a piece of steel, came flying toward his eyes,
Ned was busy working, and it took him by surprise.
On his cap he had his goggles, the steel went in his eye,
Now he's laid away his goggles, and to the boys has said
"Good-by"

Calipers for measuring steel wheels

In order to determine the amount of surface metal before and after turning a pair of wheels, they must be measured on the critical line which is the thinnest point in the throat of the flange. In order to determine the amount of service metal with a standard A. R. A. steel wheel gage, it is necessary to subtract from the total thickness on the critical line 1⅜-in. for passenger and 1⅛-in. for freight car wheels.

Owing to the difference in the radius on the underside of the various makes of wheels, it is impossible to



Method of using calipers for measuring steel wheels

get the correct reading at all times. By using the calipers shown in the illustration, the critical line is easily found which is indicated by the long pointer which shows the thickness of this line. This pointer also shows when both freight and passenger car wheels are worn to the scrap limit.

The short pointer begins to register the amount of service metal after the long pointer passes by the scrap limit, thus all measurements are shown at the same time without the necessity of subtracting the scrap metal from the total measurement of the critical line.

Decisions of the Arbitration Committee

Stencilling charges for triple valves

On February 20, 1923, the Southern Pacific cleaned and tested the cylinder and triple valve on N. O. T. & M. box car No. 686, at which time they removed a New York H-1 triple valve and applied a K-2 triple valve and stencilled the car for a standard, K-2 triple valve, charging the car owners $30.40 for the difference in value of a non-convertible valve removed and A. R. A. standard valve applied, and 0.5 hr. labor for stencilling the car. On June 30, 1923, the Gulf Coast Line returned the repair card to the Southern Pacific objecting to the charge of $30.40 on the grounds that the car was built during 1907 and the charge should be reduced to $11.30, the conversion price, in accordance with Interpretation No. 6, Rule 17, which states that on cars built prior to January 1, 1915, the charge shall be on the basis of the conversion price of $11.30, plus allowance for removing, repairing and replacing triple valves, as per Item 29 of

Rule 111. The Southern Pacific refused to confine the charge to $11.30 as requested by the Gulf Coast Lines, claiming that the car was stencilled "rebuilt 2-21" and that the rebuilt date should govern the charge for the change of triple valves.

The Arbitration Committee in rendering its decision stated that according to the evidence presented, the car did not bear stencilling showing the date built prior to January 1, 1915. The bill of the Southern Pacific is sustained.—*Case No.* 1356, *Gulf Coast Lines vs. Southern Pacific.*

Damage caused by a defect on another car

On January 7, 1923, M.-K.-T. 60,000-lb. capacity wooden box car No. 88562 received extensive damage while in the possession of the Indiana Harbor Belt at its Blue Island station. Defects on this car developed while a locomotive was shifting a cut of 19 cars, consisting of 18 loads and one empty, the first out being the car in question. This car was kicked onto a track and when the engineman attempted to stop, the other 18 cars broke off next to the locomotive, ran down the track and struck M.-K.-T. car No. 88562, resulting in damage to five longitudinal sills, two end sills and two crosshead members, together with various other minor defects. After the car was repaired, a bill amounting to $318.31 was presented to the car owner. The owner road refused to pay the bill, claiming that the handling line was responsible for the cost of these repairs, basing its contention on provisions of Paragraph E, Rule 32 of the 1922 Revised Code of Rules, which provides that the handling line shall be responsible for defects developed on account of handling cars with broken or missing couplers or couplers out of place. The owner maintained that had this car been properly inspected, the handling line would not have attempted to handle a cut of cars with a defective drawbar on the car next to the locomotive. The handling line's version of the situation was that the damage was caused by a coupler on another car dropping down. The damaged car was not being handled with a defective coupler as this defect originated in switching. It contended that the car owner was responsible as the car was not subjected to any of the unfair conditions specified in Rule 32.

In rendering its decision, the Arbitration Committee stated that Case No. 1231 is parallel and the same decision applies. This decision reads as follows: "The accident was caused by a collison when six cars broke away as the engineman applied the brakes while backing on the siding, making the damages the delivery line responsibility.—*Case No.* 1358, *Indiana Harbor Belt vs. Missouri-Kansas-Texas.*

Responsibility for car damaged in back-up movement

On March 27, 1924, a Gulf Coast Line train of 101 cars was backed onto a track to do some switching work, during which movement the conductor pulled the air from the caboose to make a stop and in doing so broke in two S.F.R.D. car No. 9956 and knocked G.C.L. caboose off center. The G.C.L. furnished an inspection report of S.F.R.D. car No. 9956, advised that it would cost $1,910 to repair the car and requested disposition under A.R.A. Rule 120. The handling line claimed, that as the train was backing up, the caboose was the head end of the train and that it was proper to apply the air from the caboose; therefore, the car owner was responsible for the damage under such conditions. The handling line stated further that the car was not subjected to any unfair usage and, therefore, Paragraph 5, Rule 32, did not apply in this case. The Atchison, Topeka & Santa Fe claimed that regardless of the direction in which the train was moving, the locomotive was the head end and that the damage caused by setting the air brakes at the caboose end was done from the "rear end" and is chargable to the handling line. The car owner contended further that the car was damaged by unfair usage in accordance with Interpretation No. 5 of A.R.A. Rule 32, which states in part "However, emergency application through manipulation from rear of train is unfair usage."

The Arbitration Committee rendered the following decision: "The caboose in this case must be considered under Interpretation No. 5 to Rule 32 as the rear end of train. The handling line is responsible."—*Case No.* 1359, *Gulf Coast Lines vs. Atchison, Topeka & Santa Fe.*

Industrial cars not equipped with quick-action triple valves

Ohio crane No. 1940, an industrial car traveling on its own wheels on revenue billing, as per note to Rule 3, page 17, of the 1923 Code of A. R. A. Rules, was received from the Norfolk & Western by the Caroline, Clinchfield & Ohio at St. Paul, Va., April 23, 1924, at which time the car was equipped with a 1¼-in. air brake pipe and angle cocks, an efficient hand brake, but no triple valve or reservoir. When the car was received at the Erwin, Tenn., shops of the C. C. & O., it was given the usual inspection and placed on the repair track to be equipped with power brakes. At the same time the repairing line requested the inspector at St. Paul, Va., to furnish an N. & W. defect card for the missing triple valve and reservoir, according to Rule 58. The N. & W. contended that a defect card was not due for these items on industrial cars traveling as per note to Rule 3, page 17 of the 1923 Code of A. R. A. Rules. The repairing line contended that the note to Interchange Rule 3 waives the provisions and requirements of Section (a), Rule 3, second paragraph only, insofar as it concerns cars of this class and that the note has no bearing on the first paragraph of Section (a), Rule 3, regarding any quick-action triple valve other than the A. R. A. standard type, and that a defect card for a missing triple valve and reservoir was due according to Rule 58. According to the specific wording of the rule and note in question, it was the further contention of the repairing line that cars of this class must be equipped with a quick action triple valve and that the note under A. R. A. Rule 3 on page 17 eliminates the requirement of the second paragraph of Section (a), Rule 3, that it is necessary that such cars be equipped with A. R. A. standard triple valve even though the car was built after January 1, 1919. Confusion regarding the acceptance of industrial or export cars shipped in accordance with Rule 3 arises from the failure to definitely determine the difference between any quick-action triple valve and the A. R. A. standard triple valve. The definite wording of the rule and the note in question makes it evident that an industrial car built after January 1, 1919, may be accepted in interchange without a K type, A. R. A. standard triple valve, but must be equipped with some type of quick-action triple.

The Arbitration Committee rendered the following decision: "The C. C. & O. was not required to accept the car in interchange. There is no rule requiring the delivery line to issue a defect card in a case of this kind. Therefore, the claim against the N. & W. for a defect card is not sustained."—*Case No.* 1357, *Carolina, Clinchfield & Ohio vs. Norfolk & Western.*

Setting valves of three-cylinder locomotives

By Jack Britton

Formerly Master Mechanic, Canadian National, Montreal, Que.

THREE-CYLINDER locomotives usually have two outside cylinders arranged in the same manner as for two-cylinder engines; the third cylinder, however, being located between the main frames underneath the smokebox or front end of the boiler. A crank axle is used when building up the driving wheels to which the main rod of the third or inside cylinder is connected.

H. N. Gresley, Chief Mechanical Engineer, London & North Eastern, invented a system of levers, etc., whereby the valve for the inside cylinder of a three cylinder locomotive derives its motion from the movements of the valves of the two outside cylinders. Fig. 1 shows a plan view of the assembly; Fig. 2 shows the arrangement of the three cylinders and a front view of the levers. The middle cylinder with its guide and crosshead is located on an incline and the main rod of the middle cylinder is connected to the second pair of driving wheels.

The outside valve gears are of the usual design applied to two-cylinder locomotives and all adjustments are made in the same way as for two-cylinder locomotives. Fig. 3 shows the outside main rods as they are connected to the third or main pair of driving wheels. The right main pin of the main driving wheels, shown at *A*, Fig. 4, leads the left main pin *B* by 120 deg. or a third of a circle in the forward gear. The main driving wheels are connected by side rods to the second pair of driving wheels as shown at *C*, Fig. 4. The main pin of the second pair of driving wheels is shown at *D* the location being the equivalent of a spacing of 120 deg. or a third of a circle from each of the outside main crank pins. The outside and inside valve stems carry valve stem extensions at the front as seen in Figs. 1 and 3; the front end of each valve stem extension has a bearing support. The inside valve gear consists of two transverse levers located in front of the cylinders and connected to the valve stem extensions.

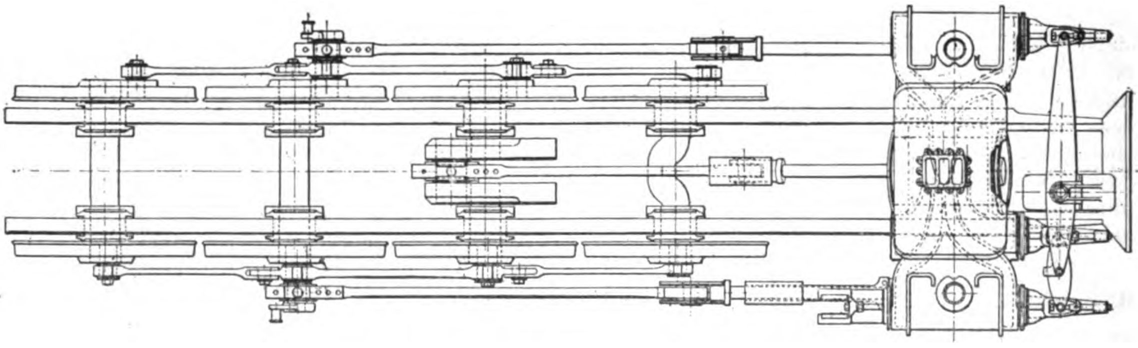


Fig. 1—Plan view of the valve mechanism of a three-cylinder locomotive

A line sketch of the levers and valve stem extensions is shown in Fig 5. The long lever is fulcrumed at *A*, the fulcrum bracket of which is rigidly fastened to the structure of the locomotive. A suitably arranged buckle, which forms part of the valve stem extension, is fitted to the front end of each valve stem as shown at *B*, Fig. 5. A short link connects each valve stem extension with its respective lever as shown at *C*. The middle point of the short lever is pivoted to the end of the short arm of the

long lever as shown at *D*. The ends of the short lever are connected by the links to the extensions of the right and the inside valve stems as at *E* and *F*, Fig. 5.

With the exception of a small allowance to compensate for lost motion, the long arm *G* of the long lever is twice as long as the short arm *H* of the long lever. Except for a similar allowance for lost motion, the arms *J* and *K* of the short lever are equal in length.

As the outer end of the short lever is driven by the right-hand valve gear, its inner end has a similar but opposite motion except as it is modified by the movement of its pivot point *D* which receives its motion from the left hand valve gear. The resultant motion is similar to that of the outside valves and so timed that with the right and left cylinders connected 120 deg. apart, the motion of the inside valve will be correct for the middle cylinder 120 deg. from the right and left cylinders.

Valve setting details

The right and left valve gears are adjusted in the same manner as for two-cylinder locomotives and should be completed, with all the necessary changes actually made and the gears reassembled before checking the motion of the inside valve.

In order to adjust the inside valve gear, it is only necessary to apply washers of the proper thickness on the valve stems where they fit into the valve stem extensions which are properly adjusted. Let the washer *A*, Fig. 6, at the right valve stem extension be replaced by another washer ⅛ in. thicker. Since the lengths of the arms *J* and *K*, Fig. 5, of the short lever are equal and are pivoted as at *D*, Fig. 5, the inside valve will be moved back ⅛-in., as shown at *B*, Fig. 6. Again, let the washer at the left valve stem extension *C*, Fig. 6, be replaced by another washer ⅛ in. thicker. Since the long arm *G*, Fig. 5, is twice as long as the short arm *H*, Fig. 5, the pivotal point *D*, Fig. 6, will be moved backwards 1/16 in. by the second change. Owing to the right valve stem and its extension remaining stationary with regard to the second change and the point *D* being moved backwards 1/6 in., the short lever is the means whereby the middle valve is moved backwards ⅛ in. by the second change as shown at *F*, Fig. 6. In order for the inside valve stem to be re-adjusted in length to square the valve events the same as before, the washer thickness changes are made to the front ends of the outside valve stems. It is necessary to reduce the thickness of the washer at *E*, Fig. 6, ¼ in.; that is, an amount equal to the sum of the changes in the thicknesses of the two outside valve stem extension washers.

The inside valve events are affected when the following changes are made:

First—If a length change is made to an eccentric rod or valve rod on an outside valve gear, the valve events on that side are affected as well as the inside valve events.

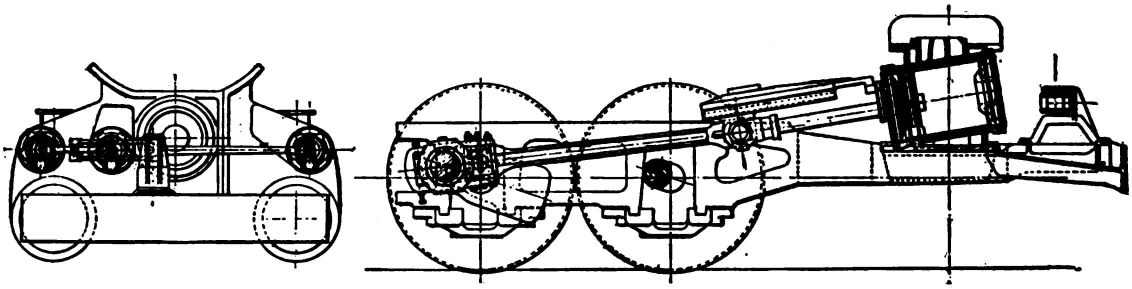


Fig. 2—At the left is a front view of the valve lever arrangement and at the right is the inclined middle cylinder with its guide and crosshead

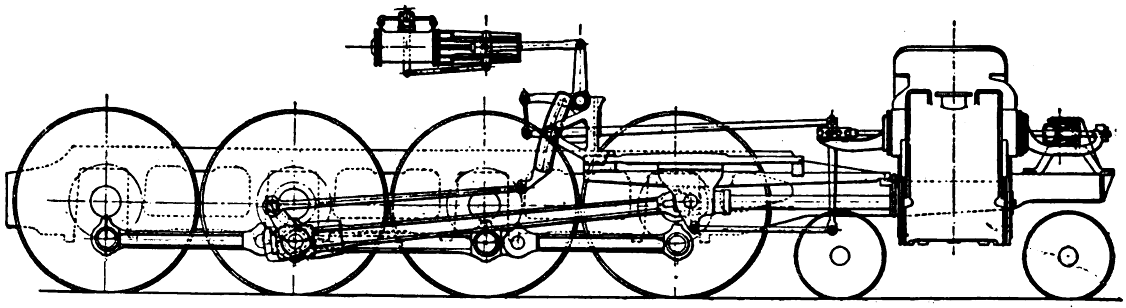


Fig. 3—The outside main rods of a three-cylinder locomotive, connected to the third pair or main driving wheels

squares the valve events at the running cut-off of say 33 per cent forward motion. When applying thicker or thinner washers to the valve stem extensions, it must be remembered that the inside valve will be moved the amount of the change in the thickness of the washer, regardless of whether the change is made at the inside stem or at one of the outside stem extensions; that is, a 1/16-in. change at either stem will move the inside valve 1/16 in., or if the washers are changed at more than one valve stem extension, the inside valve will be moved the sum of the changes in the washer thicknesses.

The following example is chosen for a clear understanding. Let it be assumed that the three valve gears

If a length change is made to either eccentric rod or a valve rod, or a change is made in the thickness of a valve stem extension washer on both outside valve gears, the effect on the inside valve events is equal to the sum of the effects caused by the changes made on both the outside valve gears.

Second—If only a valve stem washer (not a valve stem extension washer) thickness is changed to square the events of an outside valve, the inside valve events are not affected provided that the valve stem extension on that side is replaced in the same manner as before the change was made.

Third—If an outside valve stem extension washer

thickness is changed, the outside valve events on that side are not affected but the inside valve events are affected.

Fourth—If the inside valve stem extension washer thickness is changed, the inside valve events are affected, but the outside valve events are not affected.

Port marks and valve stem expansion allowances

When setting the valves on a cold engine, whether fitted with a superheater or not, due regard for the expansion of the various parts when the engine is working under steam must be considered. When taking port marks on the valve stems, or brackets if used, of a three-cylinder locomotive equipped with the Gresley levers, make the same allowance for expansion if inside admission valves are used on the outside cylinders. When taking the port marks on the valve stem, or brackets if used, of the inside cylinder, make an allowance of 3/64-in. in a case where inside admission valves are used and 5/64-in. if outside admission valves are used, but in both cases instead of center popping the port marks ahead, center pop them behind.

There may be a slight variation on some locomotives from this procedure of obtaining the port marks mentioned, but not enough to affect seriously the valve events. Checking up on one locomotive of each class will determine this.

When a valve stem tram is used to scribe the lines necessary to obtain the port marks and the scribed lines, the straight line on the three valve stems respectively shown in Fig. 7 is marked at *A* and *B*. The center *C* is then found in each case. If inside admission valves are used, it is to be noted that the center from which to lay off the port marks for valve setting purposes is marked off for the right and left valves, 1/32 in. ahead as shown at *D*, Fig. 7, and for the middle valve 3/64 in. behind as shown at *E*, Fig. 7.

If outside admission valves are used on all three cylinders, then in the case of the right and left valves, no allowance is made and the center *C* is the center of the port marks *A* and *B*, Fig. 8, which are to be used for valve setting purposes. The center *E*, Fig. 8, from which to lay off the port marks for the middle valve is center popped 5/64 in. behind the center of the points *A* and *B*.

The reason for the above procedure may be followed

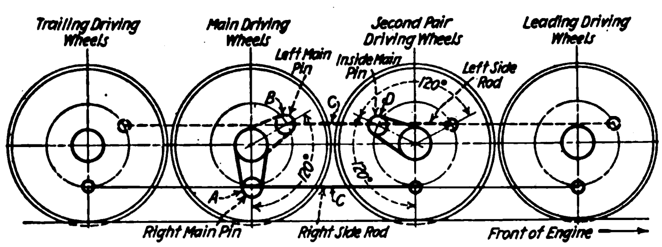


Fig. 4

step by step, using a superheater locomotive as an example.

First—The 1/32-in. allowance ahead when taking the port marks on the outside valve stems when inside admission valves are used, allows for the slight difference in the expansions between the valve stem and the cylinder which occurs behind the center line of the valve seat or valve chamber, also to compensate more or less for the mean volume occupied by the piston rod, at the various cut-offs. Certain tests made on superheater engines with various temperatures in the steam chests, proved this allowance to be suitable for the majority of locomotives. In the case of outside admission valves, no allowance is made because the difference in the expansions between the valve stems and cylinder behind the center of the valve seat is compensated by the mean volume of the piston rod when the variable cut-offs are considered.

Second—In the case of three-cylinder locomotives where the Gresley system of levers and valve stem extensions are used, the extra length of the valve stem on the front end affected by the superheated steam increases the difference in the expansions between the valve stems and the cylinders. This occurs on both outside valve stems and both have an equal effect, the sum of which is reflected on the middle valve events. This is common to all three-cylinder locomotives no matter whether inside or outside admission valves are used.

Third—The difference in the expansions between the

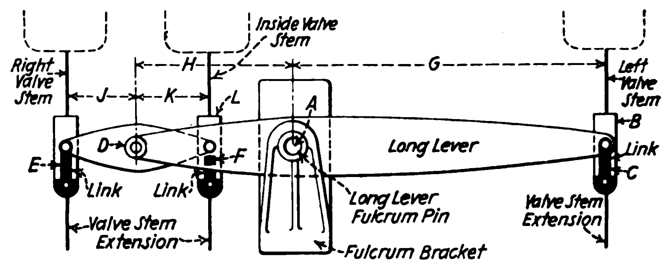


Fig. 5—Front levers and valve stem extensions

middle valve stem and the cylinder in front of the center line of the valve seat or valve chamber and the allowance for the mean volume of the piston rod of the inside engine must be considered.

Fourth—The frame splices expand with the cylinders and carry the long lever fulcrum bracket ahead, which, however, does not affect the valve events on the middle cylinder in any other way than that mentioned in the three previous items.

Where an allowance of 1/32 in. is made when taking port marks for the outside cylinders where ***inside admission*** valves are used, and no allowance is made where ***outside admission*** valves are used as explained in item 1, it is to be noted that the amount of the valve stem effective expansion, which has a bearing on the valve movements of the ***outside*** cylinders, occurs at the ***back*** of the valve.

The amount of valve stem effective expansion, which has a bearing on the valve events of the ***middle*** cylinder, occurs at the *front* of the valve. It is to be noted, when taking port marks for the valve of the middle cylinder in the case of outside admission valves as compared with inside admission valves, that the allowance to be made is greater for an outside admission valve than for an inside admission valve.

It might be added at this time that when the boiler as well as other expansion effects on valve movements are properly understood, greater confidence will be established and definite methods may be more closely followed.

Motion fitting—In the case of a three-cylinder locomotive, the same particular care must be exercised in checking the accuracy of the dimensions, the relative location of the parts, the removal of all unnecessary sets and twists from the various parts and the ensuring of freedom of movement of the parts separately and collectively during the assembly which precedes valve setting operations as is taken when setting the valves on a two-cylinder locomotive.

Bump marks and crosshead travel—The method of determining valve bump marks, piston bump marks, and main crosshead travels is the same as the method used for the Stevenson gear.

Dead centers—On two-cylinder locomotives the cylinder center line is usually 2½ in. or 3 in. above a straight

line which corresponds with the level of the driving wheel centers. Owing to this fact, the angle of a main rod is slightly different when the main pin is on its back dead center as compared with when it is on its front dead center as is shown at *A* and *B*, Fig. 9, which are exaggerated angles for the sake of clearness. This means that the front and back dead centers when found on the driving wheel are less than 180 deg. apart when measured one way and more than 180 deg. apart when measured the other way as is shown in Fig. 10.

In the case of the three-cylinder locomotive the four dead centers for the outside cylinders only are found on

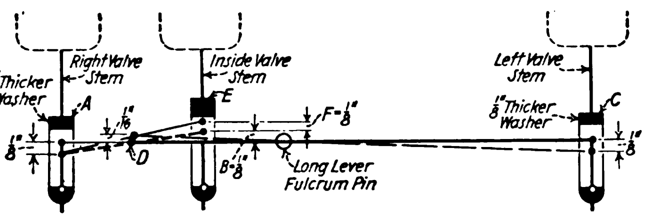
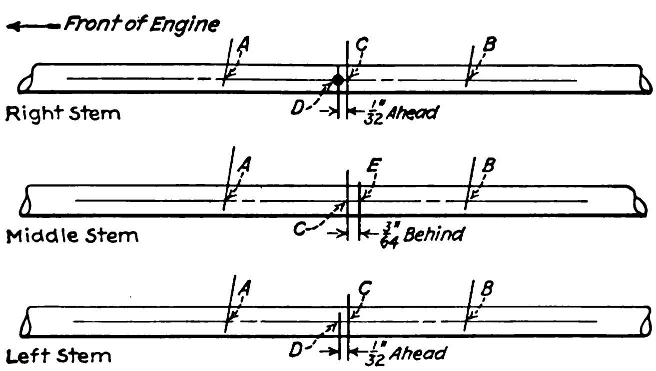


Fig. 6

the right main driving wheel in a manner similar to locating them on two cylinder locomotives. The two dead centers for the inside cylinder are not required for the following reason. The designer lays out the inside valve gear in a way that will insure good steam distribution when the outside valve gears are set correctly and the inside valve gear adjustments are made after the outside valve gear adjustments are actually completed.

Long valve travel—When the main pin of either the right or left inside cylinder is placed on a top or bottom working quarter, with the reverse gear in mid-position, the valve of the engine spotted on the quarter will be placed approximately on the center of its seat so as to cover both steam ports. By moving the reverse gear from one full gear position to the other, the valve will be moved through its long valve travel.

Short valve travel—By revolving the locomotive with the reverse gear in its mid-position, the valves of the three



Inside Admission Valves Used

Fig. 7

cylinders will move through the lap and lead travel or the short travel of the valve.

Cut-offs—If the cut-offs are required for the inside cylinder, rollers must be used under the second pair of driving wheels as well as under the main driving wheels with the side rods connecting these drivers.

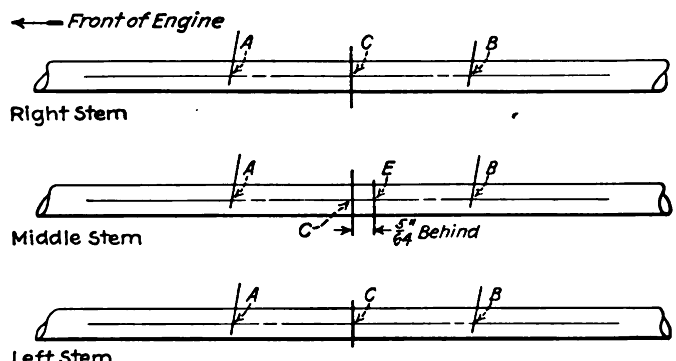
Important points to remember when setting the valves

The valves of the outside cylinders are set in the same manner as for two-cylinder locomotives dependent on the valve gear used. The setting of the valves on the two outside cylinders must be completed and the changes actually made before taking a valve reading to determine the adjustment required for the inside valve gear.

When taking port marks on a cold engine for valve setting purposes, due allowance should be made for valve stem expansion effects and piston rod volumes where necessary, on the inside as well as on the outside valve stems or brackets, if used. It should be thoroughly understood in what way the middle valve is affected by changes made to the outside valve gears or to the thickness of the valve stem extension washers. If any change is made in the adjustment of the outside valve gears, the inside or middle valve position must be rechecked.

After all valve setting adjustments have actually been made and valve motion report details taken if required, the main reach rod may be lengthened sufficiently to counteract boiler expansion effects, if any, on the valve gears.

When setting the outside Walschaert valve gears, the standard practice should be followed, except for the final lengthening of the main reach rod to counteract the boiler



Outside Admission Valves Used

Fig. 8

expansion effect on the valve gears; this operation is performed later. When the outside valve gears are properly set, with all the changes made and the parts reassembled, the rollers are left under the main drivers for use in setting the inside valve gear. Assemble the parts of the inside valve gear, checking the dimensions of the parts, including the valve stem extensions and the relative location of the long lever fulcrum pin and bracket.

Remove unnecessary rod sets and twists and try all parts for freedom of movement while assembling them. Place the reverse gear in the full gear forward position, roll the main drivers ahead until the outside valve stems move, then continue until, for instance, the right main crosshead reaches one-third of its stroke after leaving the front crosshead travel mark, then stop. Suppose the stroke of the right main pin is 30 in., then stop when the crosshead has moved 10 in. from the commencement of its travel. Hook up the reverse gear toward its mid position until the port mark of the right front forward cut-off arrives exactly underneath the valve stem tram point, when held in the same position as when taking port marks on the right side, then stop.

Drop the reverse lever catch into the nearest slot in the quadrant or otherwise secure the reverse gear in this position. With the reverse gear in this 33 per cent running cut-off position, roll the main drivers forward until the front and back inside valve travel lines are scribed on the inside valve stem or bracket if used.

Find the center of these valve travel lines with a pair of dividers and if it coincides with the center of the port

marks, the inside valve events will be correct. If these points do not coincide and say, for instance, the center of the port marks is 1/16 in. behind the center of the valve travel lines, the inside valve stem extension washer must be reduced in thickness 1/16 in.; that is, the amount of change to be made in the thickness of the middle valve stem extension washer is determined by measuring the exact distance between the center of the port marks and the center of the valve travel lines.

Whether to increase or decrease the thickness of the middle valve stem extension washer is determined by moving the center of the port marks towards the center of the valve travel lines and changing the thickness of the washer accordingly. Make the actual change required, if any, to the thickness of the middle valve stem extension washer. Place the reverse gear in the full gear forward and full gear back positions respectively and scribe the inside full gear valve travels.

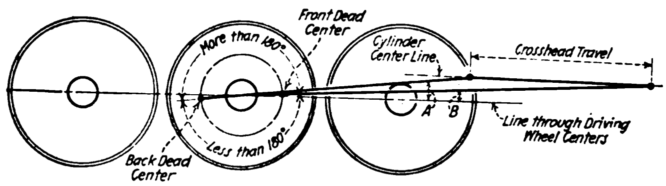


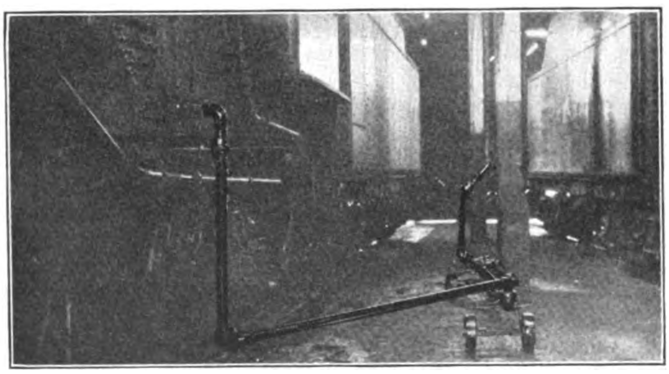
Fig. 9

With due regard to the full gear valve travels on all three cylinders and the respective valve bump marks as well as the specified full gear valve travels, adjust the reverse gear stop pins. Finally lengthen the main reach rod to counteract the boiler expansion effect on the valve gears, if any.

When the engine is first moved slowly on the outgoing track, the main crosshead travels of the middle cylinder must be scribed and the inside main rod properly adjusted for length accordingly.

Flexible pipe for locomotive blow back operation

IMPROVEMENTS have recently been made in the Cumberland, Md., shops of the Baltimore & Ohio, in the operation of locomotive boiler washing, by providing a better method for the coupling up or connecting of the boiler with the enginehouse piping system, for the blow back operation.



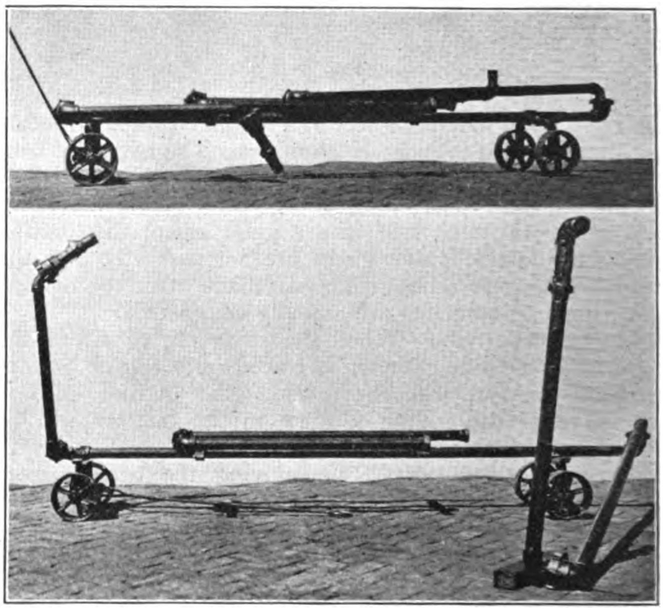
How the apparatus is used

In the past, hose of various makes, types and construction had been used for this operation. Since hot water and steam at high temperature and pressure pass through this apparatus, the management provided the best and most reliable hose obtainable, such as a specially constructed armor-covered hose.

This hose is safe, but not sufficiently durable, for under the most favorable conditions the inside fabric soon deteriorates and collapses under the hot water and steam and the outer metallic armor construction is also of short life, for in a busy shop many things happen that tend to nick, dent, crush and finally cause the armor to collapse. While not of frequent occurrence, cases have been known of hose being cut in two by being run over by the wheels of a locomotive. These special hose are costly, averaging $55.50 each and the average life is 33 days and, as they are especially fitted up by the manufacturer, when any part is injured they are practically unreclaimable locally.

Further, in the handling and transporting of the hose from one point of operation to another, it requires the services of two men, as they are too heavy and cumbersome for one man to handle.

To provide a better, safer and a more economical means of carrying out this operation, a method has been designed, as shown in the accompanying illustration, by Master Mechanic F. W. Fritchey and developed by C. M. Kennedy, pipefitter foreman, of the Cumberland shops. This device has been in service for over two months and is giving excellent results.



The upper view shows the apparatus folded and ready to be wheeled where needed, while the lower view shows the device extended and in shape to be attached to a boiler and enginehouse piping system

It will be observed that it is constructed of a system of piping and metallic flexible joints and is mounted on a set of four small wheels. It is easily handled, transported and coupled—in fact, all operations are performed by one man. It is practically indestructible and if any part should be damaged, it can be repaired or reclaimed locally. The initial cost of this device was $64.94, which includes labor and material.

The description of this device was secured through the courtesy of the Baltimore and Ohio magazine.

FOOTBOARD AT REAR OF SHIFTING ENGINE NOT REQUIRED.—The Circuit Court of Appeals, First Circuit, holds that neither the Safety Appliance Act, nor I. C. C. regulations require a footboard at the rear end of the tender of a shifting engine. The commission has only prescribed how, if one is used there, it shall be constructed and applied.—C. V. v. Perry, 10 F. (2d), 132.

Co-ordinated production control

Its functions and accomplishments in the North Little Rock Shops of the Missouri Pacific

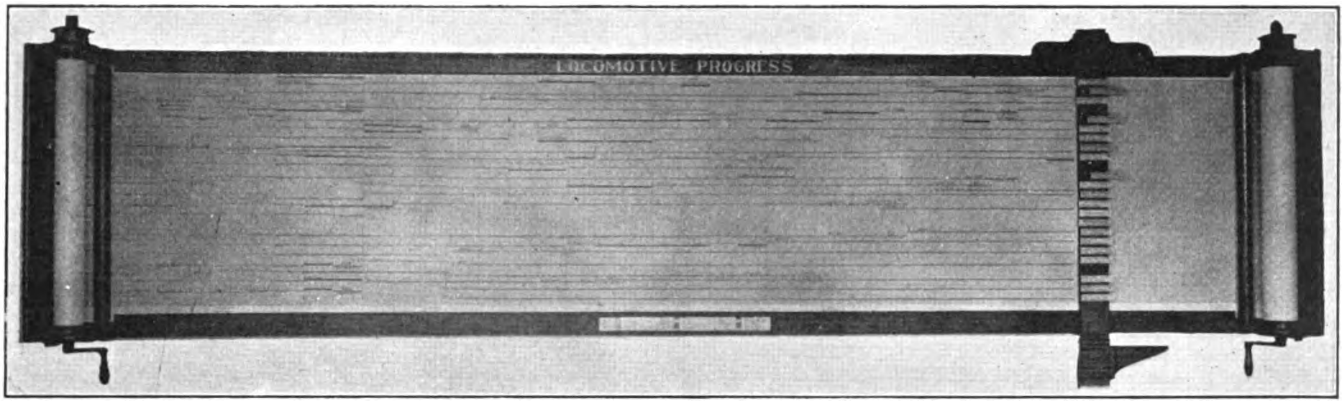
THE practical application of an up-to-date schedule and shop production plan which has been "sold" to the entire supervision and forces of the Missouri Pacific 24 pit locomotive shops at Little Rock, Ark., has resulted in a marked increase in locomotive output and reduced unit costs during the past few months. A comparison of the shop output in 1924 and 1925 is shown in Table I while Table II indicates the generally heavier character of the work. There was essentially no change in the number of men employed, the division between the various crafts being shown in Table III.

In compiling the record of schedule or shopping days in Table IV Sundays and holidays are not included. The report shows a reduction in shopping days during the past nine months of 10½ days per locomotive. During

A proper scheduling and routing method is comparable with the recording gages of a power plant, furnishing prompt information of delays, congestion or lowered production in time to correct the trouble without loss of output. Through a properly organized scheduling and routing plan, the officers are constantly in control of the shops. They have immediate information, in detail, of all the factors which enable them to make prompt and correct decisions.

Co-operation of shop foremen must be secured

Since the co-operation of the supervisory officers is absolutely necessary, they must be convinced that the principles of the plan are right, that their authority is not invaded and that they themselves are really running the plans in their individual shops.



Locomotive progress chart visualizing conditions of material, sequence of operation and causes of delay. The T-square shows engine numbers, date in shop, class of repairs and completion date

July, 1925, the monthly progress report revealed 155 delay days charged against the erecting floor; the February, 1926, report showed this condition reduced to 8½ delay days. The average number of engines turned out per month in 1924 was 13 3/10; in 1925, 14 5/10; to date, 16. The scheduling system has been extended to the passenger and freight car department.

Any new system is an innovation for only a short time. As it continues, if practical and clearly understood by all, it speeds up and runs more freely like a locomotive properly "broken in." The requisites of the successful

Table I—Comparative shop output of locomotives, 1924-25

	Output for 1924	Output for 1925
Class 1 repairs	8	25
Class 2 repairs	4	50
Class 3 repairs	112	98
Total	160	173

scheduling and production control plan as installed at the North Little Rock shops of the Missouri Pacific are:

A—Adequate advice regarding repairs needed in advance of the dates of shopping of engines.

B—A property co-ordinated method of routing work from stripping to erecting.

C—Hearty co-operation of officers and workmen.

D—Full co-operation of the purchasing and stores department.

The success of the functioning of the production department in the North Little Rock shops is directly attributed to the complete co-operation constantly evident

Table II—Generally heavier work was handled in 1925

	1924		1925
New boilers	6		19
New fireboxes	35		42
New cylinders	34	pairs	36
New cylinders	21	single	11
New valve gear	8		11
Superheaters	5		5
Syphons	14		68
Tank frames	41		37
Tank cisterns	14		16
Flue sheets	42		33
Reverse gear	16		20
Oil burners	6		17
Steel cabs	4		25

between everyone concerned. Some of the practical advantages of the method of co-ordinated production control used at Little Rock are as follows:

1—The history of each locomotive is chartered and its performance carefully recorded. The value of this is inestimable.

2—Repairs are planned in advance, thus preventing delays in procurement of and shortage of material inasmuch as early advice to the stores department before

shopping of either engines or cars indicate the major items needed.

3—It encourages supervisory forces to think in dollars and cents, as well as in units of output.

4—By means of an efficient stores system and stores accounting and operating system it reduces inventories to a minimum and prevents the building up of obsolete stock.

5—The setting of time for the completion of each job serves as a goal which, when fairly established, considerably expedites production.

6—The maintaining of a master chart and divisional charts shows the progress made on every locomotive repair job each day and serves to show where there is failure to meet schedule.

Table III—Average force of mechanics in locomotive department, 1925

Machinists	211
Boilermakers	66
Blacksmiths	29
Pipe fitters	31
Electricians	18
Loco. carpenters	14
Total	369

Note—Of this force of mechanics 77 were engaged exclusively on machine work for North Little Rock Round House engines and handling machine work on material for outside points.

7—The daily follow-up uncovers delays at once and makes possible immediate corrective measures.

8—Delays in the re-assembling of equipment are prevented. Work that should be done is not sidetracked.

9—Proper routing prepares the way for operations as completed by the previous group of workmen. The time lost between jobs is reduced to a minimum and material and parts necessary for repairs are on hand in proper sequence.

Form 7070 SM—11-25

MISSOURI PACIFIC RAILROAD COMPANY
Mechanical Department

MATERIAL MOVE ORDER

Date ______ Engine No. ______ Group No. ______
From ______ Shops To ______ Shops

QUANTITY	DESCRIPTION OF MATERIAL

Material received by ______ Foreman ______ Dept.

Immediately upon completion of this work, return this order to Production Department.

This form filled out and placed on hook at "material move" foreman's desk assures movement of finished material to its destination within 15 min.

Plans started with receipt of work report

The production department of the North Little Rock back shops consists of a production engineer, scheduling supervisor, material supervisor and material clerk.

The first functioning of the production department in connection with the shopping of a locomotive begins with the receipt by the mechanical department of the master mechanic's work report, outlining the class of repairs to be extended, description of the work, whether parts are to be renewed or repaired and their pattern number. This locomotive work report is compiled by the mechanical inspector while inspecting the locomotive during the course of the stripping operation, which usually requires from 12 to 24 hours with an organized stripping gang, under the supervision of a lead man.

Copies of the locomotive work report are forwarded to the shop superintendent, the supply department and the production department. The copy to the supply department serves as advance information regarding parts needed for repairs and is checked against its stock records. This record is maintained in the supply department through the operation of a control board, giving the "in shop" date of the locomotive, the date the material will be required and the date the engine is scheduled for delivery to the transportation department. This information is maintained by a material clerk who, by means of various colored tags, keeps track of the exact condition of the material. A blue tag, for example, denotes material condition being checked, a red tag that the material is ordered and a white tag that the material has been received and delivered to the shop.

All requisitions for material originate with the gang

Table IV—Scheduled and actual shopping days for a nine Months' Period

July, 1925	41	46-1/2
	Scheduled shopping days	Actual shopping days
July, 1925	41	46-1/2
August	44	44
September	43	45
October	40	44-4/5
November	34	42-1/5
December	33-7/10	41
January, 1926	30-2/10	35-5/10
February, 1926	36-6/10	38-4/10
March, 1926	32	35

North Little Rock, Ark., May, 12, 1926.

In shop 10-7 Engine No. 79 Scheduled 10-15

Due for service 10-31 Class repairs # 3 Pit 6

Shopping days -- 22

Front end and netting removed	10-7
Brake riggin and binders removed	10-7
Engine dewheeled	10-8
Spring riggin removed	10-8
Cab and running boards removed	10-8
Jacket and laggin removed	10-9
Motion work stripped	10-9
Pistons and crossheads removed	10-9
Stripping complete	10-10
Flues removed	10-10
Parts dispatched	10-10
Binders returned from Bkls, shop	10-14
Shoes and wedges machined	10-14
Furnace bearer machined	10-15
Guides machined	10-15
Shoes and wedges applied to frames	10-16
Driving boxes planed	10-17
Spring riggin returned from Bkls, shop	10-17
Furnace bearer applied	10-19
Shoes and wedges laid off	10-20
Brass work and boiler fixtures applied	10-21
BOILER TEST	10-22
Tank frame and trucks complete	10-22
Spring riggin machined	10-22
Air pumps and reservoirs applied	10-23
Laggin applied	10-23
Brake riggin returned from Bkls, shop	10-23
Engine wheeled and trammed	10-23
Motion work delivered from link gang	10-23
Tank tested and moved to paint shop	10-23
Motion work applied	10-24
Cab and running boards applied	10-24
Jacket applied	10-24
Guides lined	10-24
Piston and crossheads applied	10-26
Steam pipes tested	10-26
Valves set	10-27
Main and side rods applied	10-28
Tank complete	10-28
Brake riggin applied	10-28
Ash pan, Grates and front end complete	10-28
Air pipes and equipment OK	10-28
Out shop, Air tested, Pops set	10-29
On trial	10-30
OK for service	10-31

PRODUCTION DEPARTMENT

Typical master sheet

foreman directly responsible for the repairs on a locomotive assigned to his gang. They are then forwarded to the production department which checks for correct charges and scrap credit; and are then turned over to the "material move" gang foreman, in charge of delivery of all material. A force of eight men equipped with two power trucks and necessary trailers are employed in moving material. Material move orders are picked up every 15 min.

Information regarding new parts required is compiled when an engine is stripped. All parts, as removed, are delivered to the cleaning vats on schedule and, after being cleaned, are inspected to determine their fitness for use again, which determines the new material required.

Boiler test date the controlling factor

Immediately after the stripping operation is completed, the scheduling supervisor, through constant contact with the shop supervisors compiles a complete schedule for each locomotive, centering this activity around the boiler test date, the controlling factor.

The schedule contains the major operations and their completion date, which information is delivered in duplicate copies of the schedule to each supervisor concerned. The average number of schedule days on this property, embracing Classes 1, 2 and 3 repairs, is based on an average of 30 shopping days from the date the engine is delivered on the pits until it is O. K. for service.

Co-ordinated with the functioning of the schedule is the important factor of production control boards and the locomotive progress chart. Production control boards, installed in each department give the "in shop" date of the locomotive, the schedule completion date of the operation concerning individual departments, the boiler test date and the scheduled date of completion. These production control boards, maintained by foremen for their individual information visualize at all times the condition of locomotives under their charge.

Schedule is flexible and accurate

The schedule is, however, flexible enough to take care of minor work not in the original calculations which develops during repairs. Care is taken to have all information contained upon the schedule and production boards strictly accurate so as to make possible complete co-operation between the shop supervisory forces and the production department and create confidence in the production plan.

The continued existence of hearty co-operation in the North Little Rock back shops is responsible for a 22 per cent reduction in shopping time on locomotives in the past 12 months and this reduction in shopping days pertains only to Class 1, 2 and 3 repairs with practically the same force. The classification of repairs on the Missouri Pacific is as follows:

Class 1—New boiler or new back end. Flues new or reset. Tires turned or new. General repairs to machinery and tender.

Class 2—New firebox, or one or more shell courses, or roof sheet. Flues new or reset. Tires turned or new. General repairs to machinery and tender.

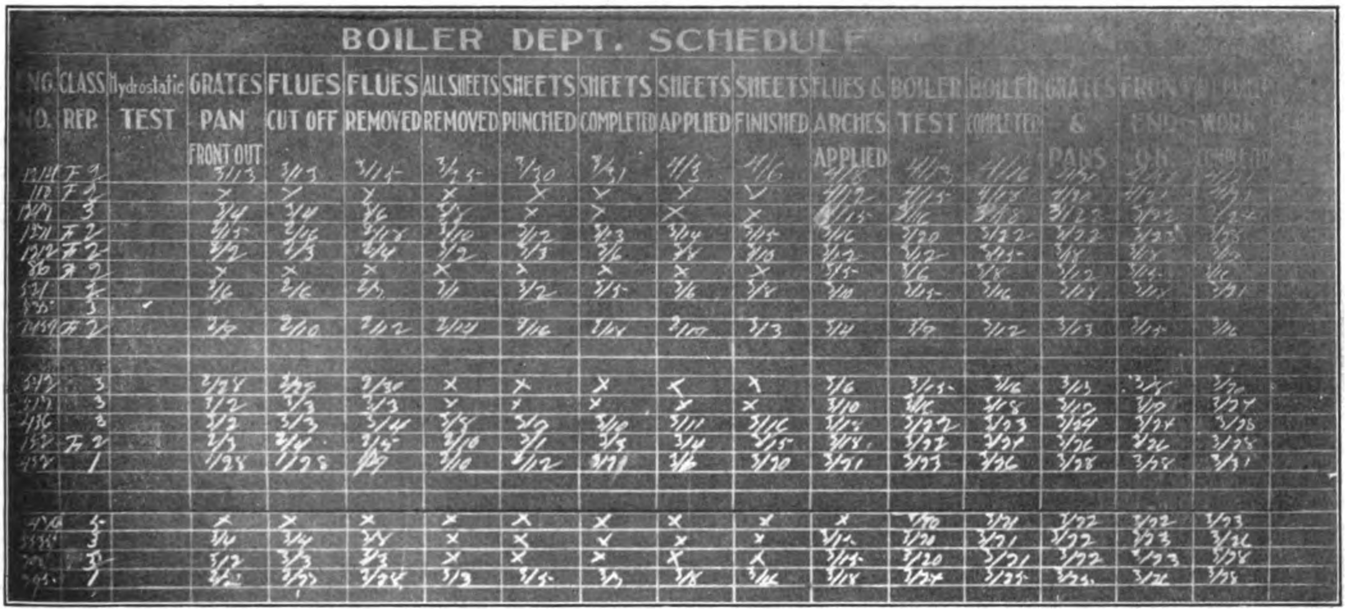
Class 3—Flues all new or reset (superheater flues may be excepted). Necessary repairs to firebox and boiler. Tires turned or new. General repairs to machinery and tender.

Class 4—Flues part or full set. Light repairs to boiler or firebox. Tires turned or new. Necessary repairs to machinery and tender.

Class 5—Tires turned or new. Necessary repairs to boiler, machinery and tender, including one or more pairs of driving wheel bearings refitted.

General repairs to machinery include driving wheels removed, tires turned or changed, journals turned if necessary, and all driving boxes and rods overhauled, and bearings refitted, and other repairs necessary for a full term of service.

The suffix A after the class designation indicates accident repairs; B indicates new boiler; BE, a new back end, and F, a new fire box.



Typical department schedule board showing the dates due

Master progress chart of new design

To visualize the daily condition of locomotives and the progress of repairs, a master locomotive progress chart is maintained in the production office, in the shop superintendent's office, and in the office of the chief mechanical officer of the system. This chart is so constructed that it operates on rollers, carrying a continuous roll of drawing paper 20 in. wide and 50 yards in length, which permits the carrying of a two years' reference record of performance of locomotives, visualizing complete data, such as date in shop, scheduled date due for service, actual date of delivery to the transportation department and the shop department responsible for any delays incurred during the shopping period.

When an engine is brought into the shop, it is entered

on the master chart under the date which is on the top of the chart. This entry is made in blue—denoting normal progress. In order to visualize completely any department responsible for delay, each department in the shop is given a distinctive color, and the departments are divided as follows:

Air department	light blue
Erecting floor	sepia brown
Tank shop	dark brown
Link and motion department	olive green
Engineering department	dark green
Blacksmith shop	purple
Machine shop	black
Stores department	red
Pipe department	orange
Boiler shop	yellow
Crane and trucking department	gray
Miscellaneous	pink
Superintendent's office	dark blue—interrupted line

As the engine progresses from day to day in the course of its repairs, the line is carried horizontally across the chart. Any delay occurring is charged to the department responsible, its representative color being inserted to replace the normal blue line—raised or lowered slightly from the direct horizontal to focus attention. For example, should the erecting floor fail to make the schedule date, the line is changed from blue to brown. The reason for the delay is specifically stated on the chart, affording a basis for immediate application of the remedy by the shop superintendent and general foreman.

Engine No. 79 MISSOURI PACIFIC RAILWAY COMPANY Date in Shop 10-1

Class Repairs 3 Mechanical Department Date out Shop 10-21

Shopping days 22

LOCOMOTIVE WORK REPORT

North Little Rock. Shop Date in Production Dept.

DESCRIPTION	New.	Repd	Patt. No	DESCRIPTION	New.	Repd.	Patt. No.
Stack		X	7140	Cylinders—Continued.			
Stack base		X	7142	Steam chest covers			
Stack extension				Pressure plates			
Front door ring	Pressed steel		"16"	Cover casing			
Door ring liner				Steam chest casing			
Front end door				Tumbling shaft			
Flag brackets	2		M-581	Tumbling shaft boxes			
Peep hole (lid and base)				Counterbalance			
Smoke arch braces							
Sand box							
Sand traps							
Dome cap							
Dome casing			12-X-3661				
Hand rail columns	15		8-X-4882	DRIVING GEAR			
Grab irons				Driving tires	Turn		
Headlight bracket	1		X-2552	Driver retaining rings			
Bell				Trailer tires			
Bell crank				Trailer retaining rings			
Bell yoke				Dr. wheel centers			
Bell frame				Tr. wheel centers			
Number plate				Front axle	1	#	8
Hand rail tops	15	X	3665	Back "	1	#	8
				CRANK PINS			
CYLINDERS, ETC.				Crank (F)	2	#	25
Cylinders	PT 24x30x1585			Crank pins (F. Int.)			
Cylinder bushing				Crank pins (M)	2	#	88
Cylinder bore				Crank pins (B. Int.)			
Splice bolts				Crank pins (B)			
Frame bolts and keys				Hub liners	8	#	4749
Heads (front)							
Heads (back)							
Casings (front)	2	X	4545				
Casings (back)	1	X	4546				
Cylinder jacket				LINK AND MOTION			
Cylinder cocks	4	X	2154	Piston heads	2	X	7122
Guide yoke				Piston Bull rings			
Guide yoke ends				Packing rings	6		
Guide yoke brackets				Piston rods			
Guide bars				Piston glands			
Guide blocks				Crossheads	2	2	489
Guide cups	2			Crosshead shoes	4	0	8475
Valve chambers				Crosshead pins			
Valve bushings				Valves			
Heads (front)				Valve glands			
Heads (back)				Valve rings and strips			
Casings (front)				Bull rings			
Casings (back)				Valve stems and yokes			
Valve seats				Valve stem guides			
Steam chests				Valve stem X-head			

Page 1 of a typical four-page locomotive work report

Short schedules afford a mark at which to shoot

One fact in proof of the success of this visualization of conditions contributing to delays is the reduction by 85 per cent of delays in the erecting department alone in the past twelve months, brought about by the advanced information furnished the various supervisors and their response to this condition through complete co-operation.

Schedules as compiled are made somewhat short intentionally, with the idea of setting a mark to aim at, thus keeping the various departments keyed up to a point where the production will approach, as nearly as possible, the mark set as a schedule. If this mark could be constantly maintained without intensive effort, the incentive element would be lacking. The efforts displayed by the supervisors in endeavoring to maintain schedules as nearly as possible is very commendable to the shop organization as a whole.

Throughout the development of this particular plan, it has been constantly explained and interpreted to all affected that the plan is of mutual benefit to every one in the shop. This viewpoint has been accepted and furnishes a big reason for the full acceptance of the plan itself. Every objection to the inauguration of the plan has been met by the facts and sound interpretations thereof. The why of the plan has been clearly explained and the shop men shown the fairness of all changes.

Removable lateral liner for engine and trailer truck boxes

*By F. W. Lampton**
and W. B. Murney†

ONE of the items which help increase the maintenance costs of a locomotive is the keeping up of the lateral motion in the engine and trailing truck boxes. A removable lateral brass liner has been developed on the Frisco for use on Mountain type passenger locomotives. The comparative test of the removable liner against the poured brass liner over a 138-mile division with plenty of curves proved conclusively that the former outwore three sets of the latter.

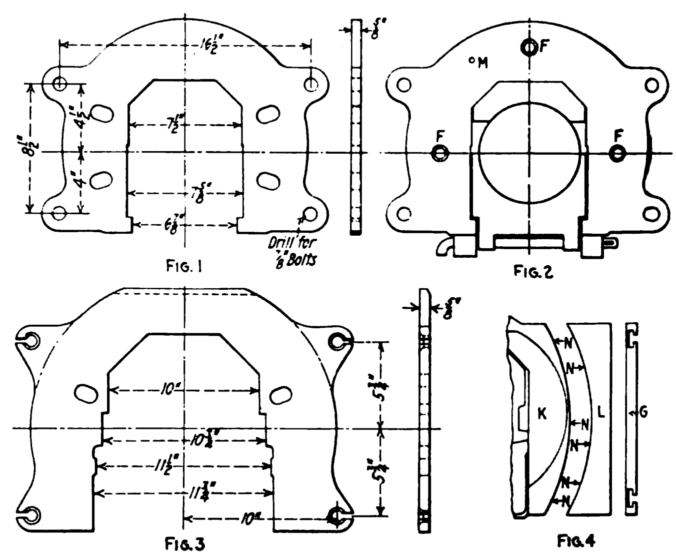


Fig. 1—Brass liner for engine truck boxes; Fig. 2—Method of applying steel liner to old engine truck boxes preparatory to the application of the brass liner; Fig. 3—Brass liner for trailer truck boxes; Fig. 4—Method of welding a new piece on old trailer truck boxes

It was found from experience that when the brass liner was poured on, it seemed to chill and would check out from the pins that were driven in the box to help hold the brass in place; also when the brass was poured into

* General enginehouse foreman, St. L.-S. F., Springfield, Mo.
† Traveling inspector, St. L. S. F., Springfield, Mo.

the dovetail part of the box, and then cooled off, it would shrink away from the box and become loose. By applying the liners as shown in the following illustration this trouble was eliminated.

Another point gained by this application is that once the engine truck boxes are equipped with the liners, the boxes never have to be removed to take up the lateral motion, as this can then be done by removing the worn out liner and applying a new liner by merely removing and replacing four ⅞-in. bolts.

In preparing an old engine truck box for the new liner, about ½-in. is faced off of the lateral side of the box. Then a liner, similar in contour to the brass liner shown in Fig. 1, is cut from ½-in. boiler plate. This plate is secured to the old engine truck box by three counter-sunk head bolts, 1 in. in diameter and 1¾ in. long, eight thread. The bolts are counter-sunk 1/16 in. under the surface of the liner and when tightened, the head is electric welded to the plate so it will not become loose or back out. The locations of these bolts is shown at F, F, F, Fig. 2.

The cast brass liner, as shown in Fig. 1, is now ready to be put in place. It is held by four ⅞-in. machine bolts with cotter key holes drilled in them. Castellated nuts are used which, with the cotter key prevents the liners from coming loose. The brass liners are cast with pockets in them to catch the grease that is fed to the liners by means of an ordinary grease cup, through the hole in the engine truck box at M, Fig. 2.

The trailer boxes are changed from their original design by cutting pieces of steel shaped as shown at L, Fig. 4, and then welded to the original box at the points marked N-N by either the acetylene or electric method. These pieces are cut out with a tee slot shown at G, Fig. 4. These slots are made so that the bolts which hold the trailer hub liner in place can be slipped in through these slots and a new liner applied without dropping the trailer wheels or any part of a trailer truck of the Delta type.

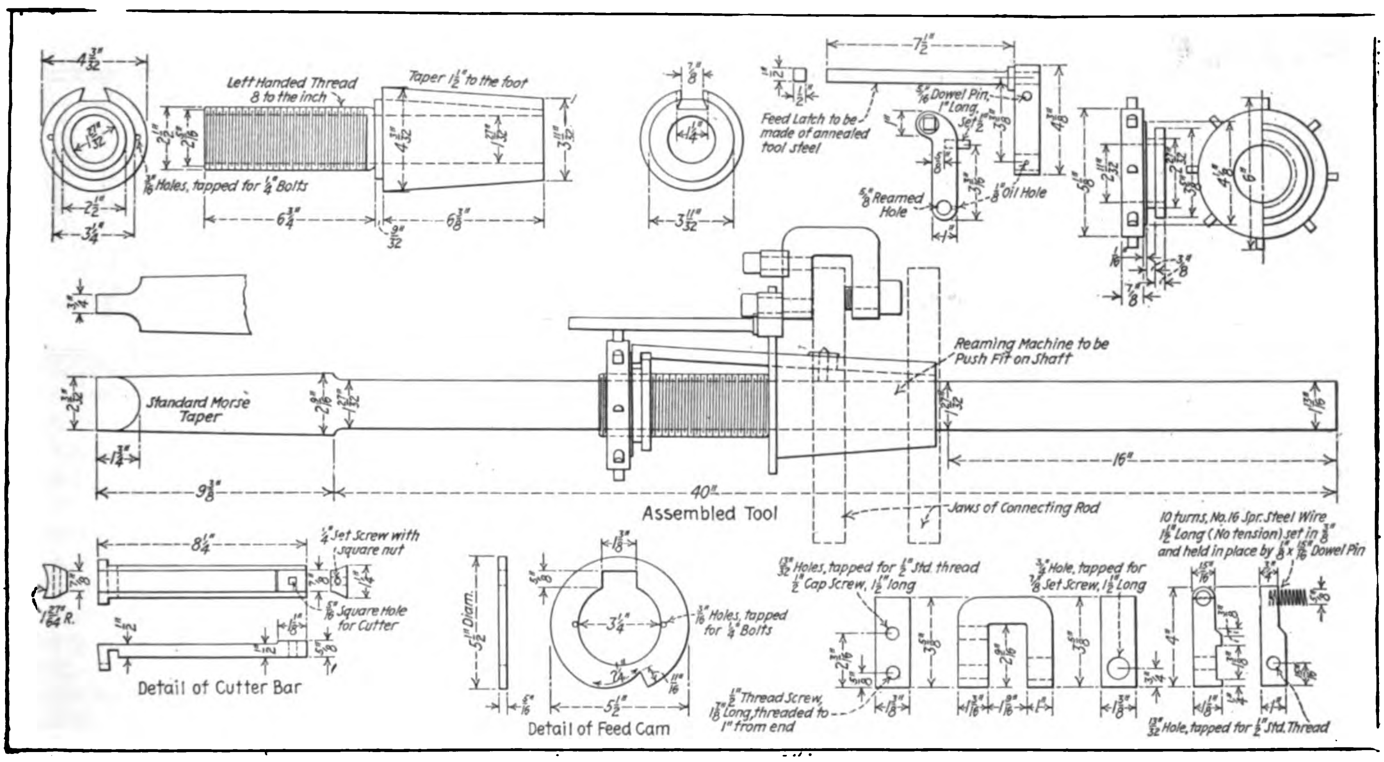
The holes in the corners of the trailer hub liners are drilled 1 5/16 in. for a ⅞-in. bolt. The hole is then counterbored ⅜ in. deep and 1¾ in. in diameter and then sawed out to the edge of the liner as shown in Fig. 3. When the bolts are slipped in place, a washer is placed on the bolt and as the washers fit into the counterbored part of the liner, they hold the bolts in place as long as there is a nut on them. With this arrangement the lateral can be taken up in a truck in about 1 hr., 30 min., where it formerly took five hours' time besides several men on the job and a great deal of handling in getting the old boxes off, pouring on the brass, facing it off and replacing.

Taper attachment for boring out side rods

By Alvah S. Duryea

Shop foreman, O.-W. R. R. & N. Co., La Grande, Ore.

The taper attachment shown in the illustrations is used on a Lucas horizontal boring mill for reboring taper holes in side rods, although with a few minor changes it could be applied to several other classes of work. The reason for using this device is that we encountered considerable trouble in getting a reamer to give good service on crome-vanadium steel. It becomes hard and glazed in service with the result that the rods have first to be bored and then reamed. This practice necessitated the removal of considerable material. We can now bore a rod in 30 min., from floor to floor, removing from 1/32 in. to 3/32 in. of material.

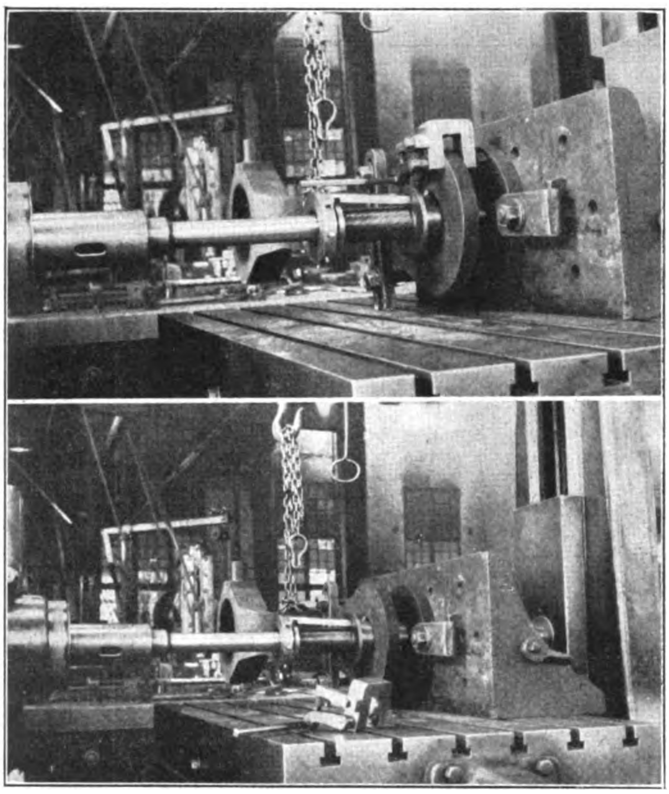


Assembled view and details of tool for reaming connecting rods on a horizontal boring mill

When making this tool the two principal factors to consider are the lead of the screw and the movement of the dowel pins in the nut, and that the portion of the flange cut away must be greater than the space between two of the pins, and not equal to two spaces or the feed will be doubled.

The head or main portion of the tool is a push fit on

the shaft, having no movement relative to the shaft. The head is machined all over and is turned to the same taper as that of the hole to be bored. There is also a sufficient amount of clearance between it and the hole. It has a narrow flange or feed cam, the periphery of which is concentric with the body except that it is cut away a short distance to allow it to act as a cam. A dove-tail slot is planed parallel to the center line in the head to receive the cutter bar. The angle formed by the extended intersection of this slot with the center line of the bar is an important point on which depends the angle or taper of the hole the tool will bore. The cutter bar passes through a clearance hole in the flange and the end is fitted in a slot in the feed nut. The nut is threaded to the shaft and advances and recedes along the thread as it rotates on the shaft. Thus, as the bar is in rotation and the nut is held stationary both the head and collar will continue to rotate with the bar, while the cutter bar and the nut will



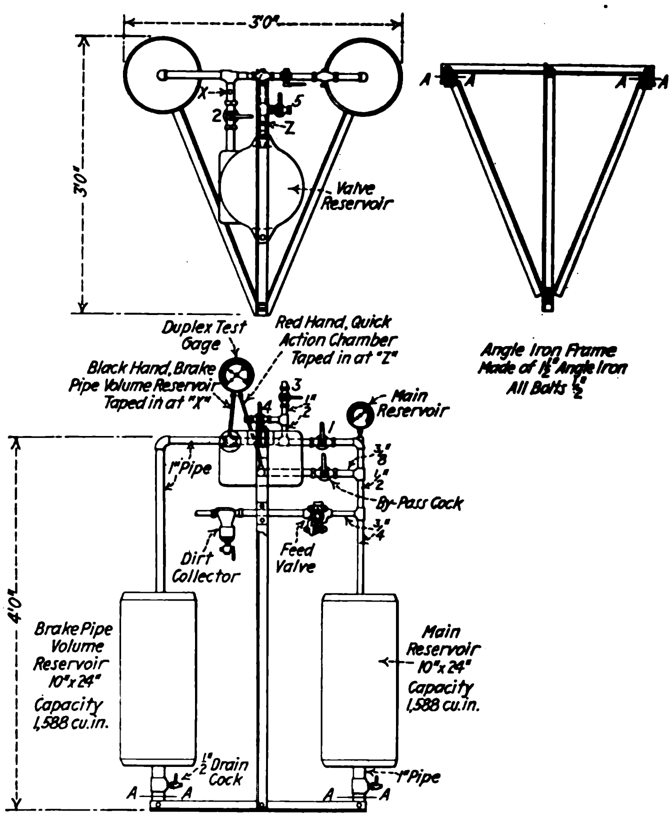
Top view shows the device in operation while the lower view shows the feed latch removed and lying on the table

move endwise with relation to the head at a rate dependent on the lead of the screw thread on the bar.

The cutting tool is a piece of high speed steel fastened by a set screw in a hole near the end of the cutter bar. All the movements necessary for taper boring are thus provided, but if the nut were to be held stationary either the thread on the bar would have to be a fine pitch or the feed would be altogether too coarse. Therefore, means are provided for retarding, or rather, intermittently stopping the rotation of the nut. This is done by a feed device or latch which is arranged to be fastened directly above the feed cam by a clamp. The diameter of the feed nut measured over the dowel pins should be the same as that of the feed cam. It follows, therefore, that if the bar revolves the hooked end of the cutter bar will ride on the flange of the threaded nut which continues to revolve with the bar. A portion of the flange has been cut away equal to a little more than the distance between the two dowel pins on the nut. When this recess reaches the feed latch it automatically drops, permitting the feed latch bar to engage one of the dowel pins holding the nut stationary. The head still revolves and on arriving at the high part of the cam releases the feed latch and allows the nut to revolve for another revolution. Since there are eight dowel pins in the nut, the tool is fed 1/8 of the thread on the bar, in this case approximately .012 in.

Rack for testing brake pipe vent valves

All of the No. 4 brake pipe vent valves repaired in the shops or enginehouses of an eastern railroad are tested on the rack shown in the drawings before being returned to service. The rack, a piping diagram of which is shown in one of the drawings, consists of two auxiliary 10-in. by 24-in. reservoirs, a cast iron reservoir, a duplex gage and single pointer gage, and five cocks, together with the necessary piping. This equipment is supported on a frame made of 1½-in. angle iron. Cock No. 1 is a ½-in. cut-out cock and cock No. 2 is a 1-in. cut-out cock with a side vent. Cocks Nos. 3 and 4 are bleed cocks with 5/32-in. and 13/64-in. chokes, respectively. Cock No. 5 is a quick action chamber bleed cock



Drawing of the rack for testing No. 4 brake pipe vent valves

and a 3/8-in. cock is placed in the by-pass line as shown in the piping diagram.

The vent valve to be tested is bolted to the cylindrical cast iron reservoir in the same manner as it is applied on the locomotive. It is then tested according to the following code.

Code for operating the test rack

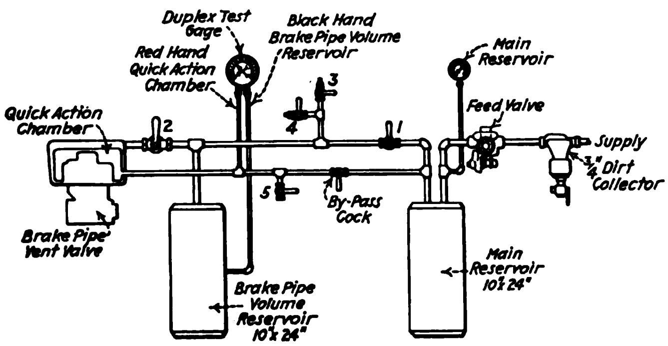
General—Before placing the vent valve on the rack, determine the friction of the piston and the slide valve by using the friction indicator, which is used for determining

friction on triple valves. The resistance to movement should not exceed 6 lb.

Make certain that the gasket between the valve portion and reservoir is in good condition and then place the vent valve on the rack. The feed valve should be set to close at 70 lb.

Charging test—Commence test with all cocks closed. Open Cock No. 1 and charge the brake pipe reservoir to 70 lb., then open Cock No. 2 and note the rate the pressure is built up on the gage leading to the quick action chamber. The charging time should be from zero to 65 lb. in 45 sec. to 80 sec. If a less time than 45 sec. is required for charging, check the No. 72 drill hole in the bushing underneath the ball check. If this is found to be the proper size, the faster charging time indicates ring leakage. At the same time, check the 1/16-in. hole in the cylinder bushing. Coat the entire valve with soap suds to detect leakage. If any leakage is found, the charging test should be repeated.

Slide valve and emergency valve leakage test—After the quick action chamber has been charged to 70 lb., place a bubble over the valve exhaust. Leakage here indicates either slide valve or emergency valve seat leakage. To



Piping diagram of the brake pipe vent valve test rack

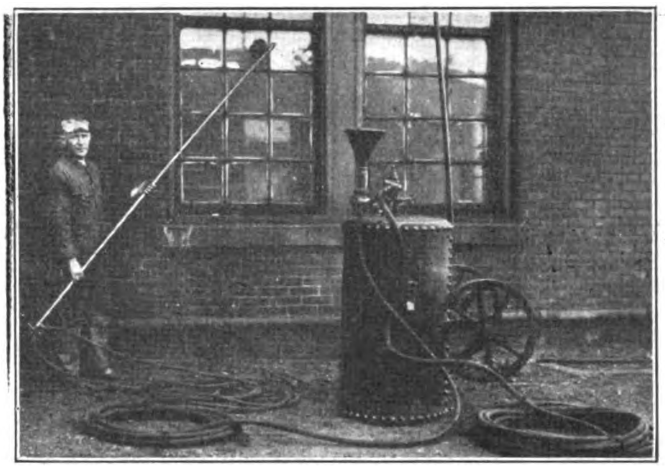
determine which valve is leaking, open Cock No. 5, which vents quick action chamber pressure to the atmosphere. If the blow continues, it indicates emergency valve seat leakage.

Service stability test—Close Cock No. 5, open the by-pass cock, and recharge the quick action chamber to 70 lb. When recharged, close the by-pass cock and Cock No. 1, and open Cock No. 3. This should not produce emergency in a 20-lb. drop. If it does, it may be caused by a restricted quick action chamber port in the slide valve, a weak graduating spring, or high friction in the emergency piston. Close Cock No. 3 and place a bubble over the vent valve exhaust. Leakage here indicates that the slide valve is leaking.

Emergency sensitiveness test—Open Cock No. 1 and the by-pass cock, and recharge to 70 lb. Close Cock No. 1 and by-pass cock, and open Cock No. 4. This should produce emergency within a 10-lb. drop. Failure to produce emergency may be due to a stuck emergency piston and a worn quick action piston ring. When emergency takes place, note the drop on the gage attached to the quick action chamber. This should be from 70 lb. to 5 lb. in not less than 10 sec. nor more than 15 sec. If less than 10 sec., it may be due to quick action piston ring leakage. If greater than 15 sec., it may be caused by a restricted vent hole in the quick action piston. Close Cock No. 4 and open Cock No. 1 slowly, and note that the quick action valve closes after emergency. Failure to close will be indicated to the operator by a continuous blow at the quick action exhaust.

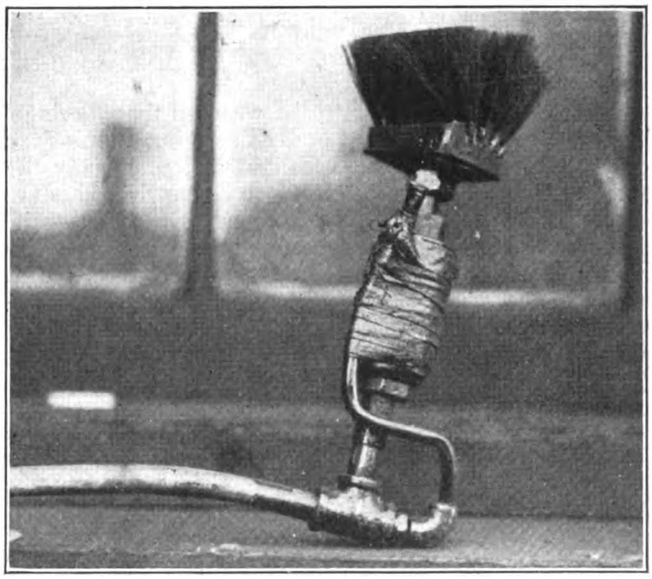
A revolving window cleaner

Gang foreman, C. E. Mortlock of the Wilmington enginehouse, Maryland division of the Pennsylvania System, has devised a window washing apparatus that it is said will wash as many 12-in. by 12-in. windows around an enginehouse in one day as two men can wash



The window cleaning equipment in use

by hand in one week. It is operated by one man, using water and compressed air. A hose is connected to a water connection and another hose to an air supply. The water flows into the tank and is then forced by air from the tank up through a long ½-in. pipe which has a re-



A revolving window cleaning brush operated by compressed air and water

volving brush on one end. The windows are thus quickly cleaned by the revolving brush.

The information contained in the above article was supplied through the courtesy of the Pennsylvania News, published in the Eastern region of the Pennsylvania Railroad.

The headquarters of the Consolidated Purchasing Agency of the American Short Line Railroad Association, together with those of its manager, J. W. Cain, have been moved from Chicago to Houston, Tex.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Tests of cast iron brake shoes—A question

San Francisco, Cal.

To the editor:

I have read with considerable interest F. H. Williams' article on comparative tests of cast iron brake shoes which appears in the April, 1926, issue of the *Railway Mechanical Engineer*. On page 211 there is a comparative statement showing the cost and wearing qualities of cast iron brake shoes, plain, chilled and with expanded metal. I am wondering whether the saving shown in this table takes into account the wear of the wheels.

It appears to me quite possible that while the expanded metal shoe shows less wear than the plain cast iron brake shoes, it may at the same time be causing more wear to the wheels than these shoes and it then becomes a question as to whether the saving in wear of the brake shoe is not offset by the additional loss in wear of the wheel.

Dennistown Wood,
Engineer of tests, Southern Pacific

The answer

Montreal, Que.

To the editor:

I have no actual tests as to the wear on the wheels or tires by the various types of brake shoes, but I am of the opinion that the wear will be slight and practically the same in all cases. The first thing to be considered is the comparative area of contact of the shoes to the wheels, during one turn of the wheel. The area of the wheel surface to that of the shoe is approximately from ten to twenty to one. The wheel is much thicker and has more surface for the dissipation of the heat generated by the friction than the shoe. Therefore, the shoe heats up and naturally wears away quickly as compared with the surface of the wheel.

The structure of the metal in the shoe and in the wheel is the next consideration. By looking at the photomicrographs in the article in the April, 1926, issue of the *Railway Mechanical Engineer*, you will note that the hardest material is not in excess and that it is like a honeycomb and not a solid mass. It is imbedded in a softer material which is softer than either the tire or chilled wheel. The thin hard network will gradually break off and become set in this soft matrix, or fly off as burnt metal and be lost. This is the actual wear.

In the case of freight car wheels or any chilled wheel there is no question but that the wheel will not wear any more with the diamond mesh shoe than with the ordinary brake shoe, and decidedly not as much as with the chilled cast brake shoe which has a solid area of 8 to 12 sq. in. of chilled cast iron of the same structure as the wheel.

I am sure that the diamond mesh brake shoe is the medium hard shoe. The chilled cast or special chilled cast shoe is too hard and the ordinary cast shoe is too soft. I have no hesitation in recommending the diamond mesh shoe for both passenger and freight car service, especially for passenger car service.

Fred H. Williams,
Assistant test engineer, Canadian National

Why Walschaert valve gear pins break

Brownwood, Tex.

To the editor:

On page 458 of the July issue of the *Railway Mechanical Engineer* Mr. Lee wanted to know the reasons why a pin should break or fall from the union link of a Walschaert valve gear while a locomotive is running at a speed of 40 miles an hour. One cause for the breakage of the union link pin would be a stuck valve on account of the lack of proper lubrication owing to the fact that the locomotive on which the failure occurred was equipped with new cylinders. Steam pressure would never break the pin.

Another defect could have been that the end of the pin was not properly drawn up tight and a cotter pin put in place for safety. Another cause could be laid to defective material or to the use of chrome nickel steel casehardened the same way that an ordinary steel carbon pin would be treated. If an alloy steel pin is casehardened in this manner, it will quickly break under the vibration set up by the locomotive. The sudden jerks to which a locomotive is subjected when running at a high rate of speed are too severe on alloy steel pins which have not been properly treated.

The reasons for valve motion pin failures are often hard to determine, but the writer has found in his experience that when pins are reported broken or missing, the failure can generally be attributed to one of the above-mentioned causes.

B. G. Miller.

Broken union link pin on a Walschaert gear

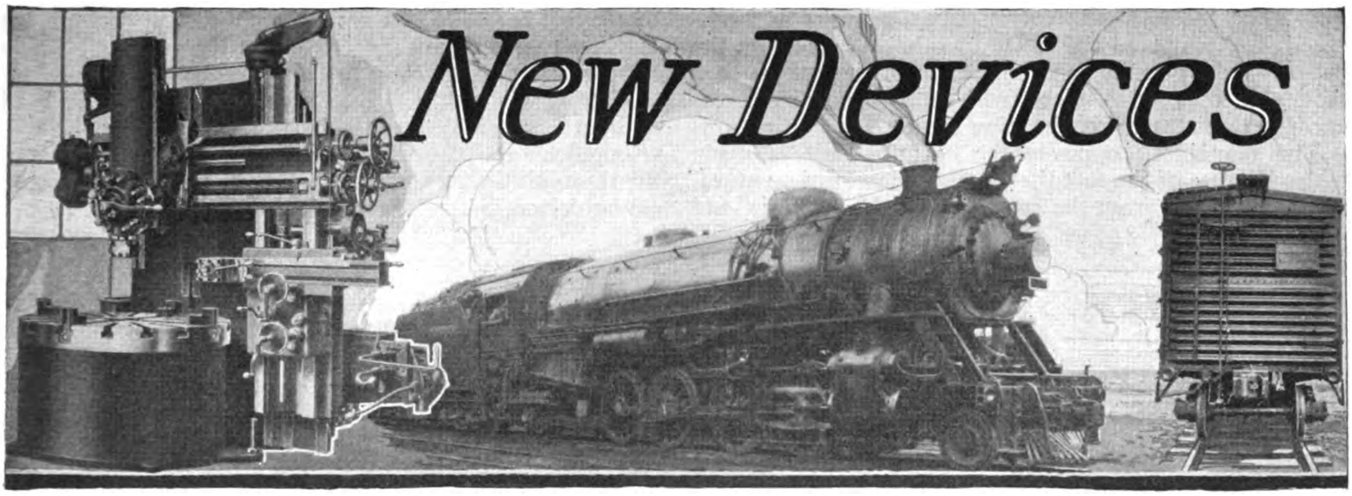
Louisville, Ky.

To the editor:

I read in the July, 1926, issue of the *Railway Mechanical Engineer* a question by C. M. Lee on the Walschaert valve gear and would also like to have the opinion of the readers relative to my conclusions as to why a cylinder fails due to the pin of a Walschaert valve gear breaking.

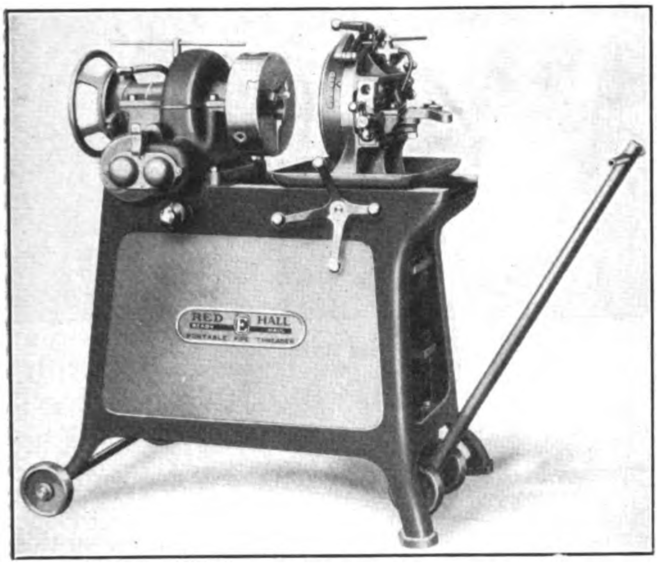
The road with which I am connected has had two or three cylinder failures of this kind. I am of the opinion that where a pin breaks or falls out of a union link, probably the valve stopped in a position covering the port, and the cylinder packing being in good condition and tight and the high speed at which the locomotive was running, created a high compression in the cylinder, causing it to break at the weaker point. In the failures referred to the cylinders were broken through the steam port and also through part of the valve chamber and exhaust cavity.

W. T. Speak.



Red-E-Hall portable electric pipe machine

HALL-WILL, INC., Erie, Pa., has recently placed on the market the first of a new line of tools known as the Red-E-Hall portable electric pipe machine. This machine is designed to handle pipe from ¼-in. to 2-in. pipe size and bolts from ½ in. to 1½ in. diam. It can also be used as a power unit, using a universal shaft, to drive hand stocks up to 12 in. While designed as a portable machine it may easily be changed over to a stationary machine in a few minutes.

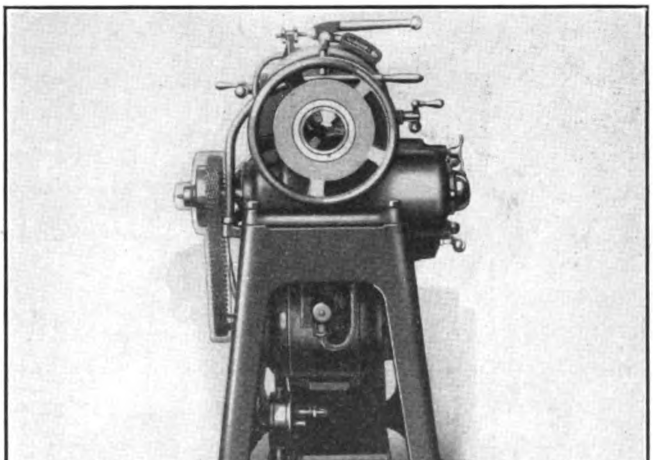


A new portable electric pipe machine which cuts and threads pipe from ¼ in. to 2 in.

Malleable iron and steel are used throughout in its construction in order to eliminate the breakage of vital parts and to provide a light-weight machine, the weight in working order is only 450 lb. For use as a portable machine a built-in elevating truck is provided, the rear feet of the machine being mounted on small wheels while the front feet have double swivel casters which elevate the front end when the handle is moved forward.

The machine is driven by a 1-hp. reversible motor, operating at 1,750 r.p.m., which is bolted to the main frame in an easily accessible position. Push or turn button controls for stopping, starting or reversing are provided. A silent chain and friction clutch transmit the power to the spindle through a three-speed selective gear transmission running in an oil bath. The gears are of heat-treated chrome-nickel steel and the shafts are mounted in Timken roller bearings.

Close nipples can be threaded without extra equipment by the use of the standard chuck. The dies are opened and closed by means of a lever on top of the die head. The die head is designed so that once it has been set to a given size it can always be brought back to the same position by pulling down the lever to the locking position. Adjustment for oversize and undersize threads has also been provided for by turning two narrow nuts on the head bracket. The outside of the cam is graduated for setting the die head for various sizes of pipe. A positive locking device is provided on the head.



End view of the Red-E-Hall pipe machine, showing the location of the driving motor

The cut-off attachment is of a new type with the block mounted on the front V-block of the machine. Adjustment of the tool block is made by means of a tapered steel

gib. The blade in the cut-off attachment is of high-speed steel tempered the entire length. A handle on the cut-off screw permits rapid operation of the cut-off tool. A double opposed V-block with interchangeable hardened steel plates holds the pipe steady for cutting off.

The rear block opposite the cut-off blade is made wider because of the fact that it takes most of the natural thrust and wear from the cut-off tool. In the front end of the bed is a chip pan and oil chute which delivers the cuttings to a chip box from the point where the oil drains off through two strainers to the oil reservoir below.

Cutting oil is forced into a chamber in the die head and three specially arranged outlets allow it to be distributed on the dies. The oil is pumped from a large oil reservoir by means of a rotary geared reversible oil pump driven direct from the main motor.

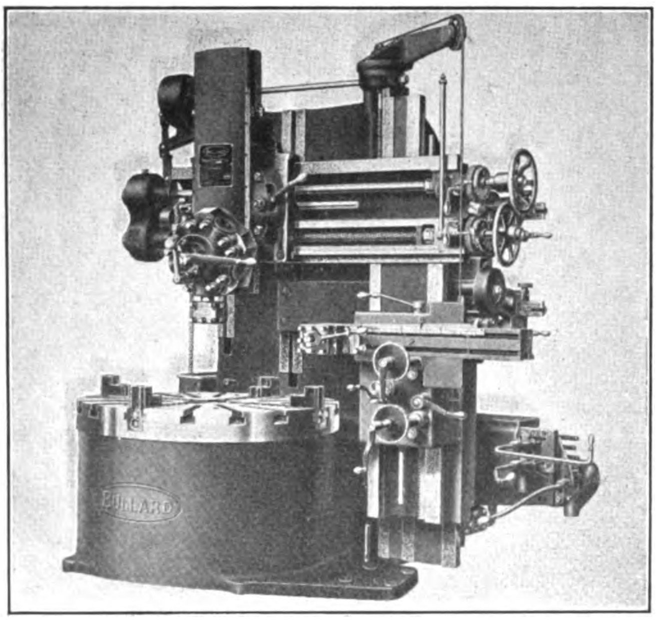
New Era 54-in. vertical turret lathe

An improved vertical turret lathe of 54-in. capacity, with one swivel turret head and one non-swiveling side turret head has recently been placed on the market by the Bullard Machine Tool Company, Bridgeport, Conn. The machine shown in the accompanying illustration has a table diameter of 50-in., but will actually swing work 56 in. in diameter. The height under the cross-rail is 35½ in., and the maximum distance from the table to the turret face is 49 in.

The table and table spindle are of the standard Bullard type, with a bevel-gear table drive. The spindle thrust bearings are ground concentrically on a machine built especially for this purpose.

The bed casting of the machine has been strengthened, and machined pads are now provided on the bed for the support of a forming attachment bracket for the side head. The forming attachment is either of the plate type for such work as the crowning of pulleys, or of the universal type that may be set to cover a wide range of angles for machining bevel gears.

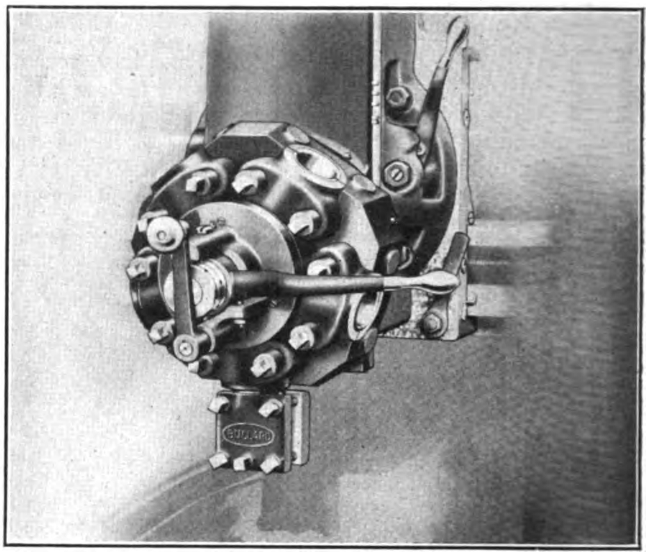
Other features that have been added to the machine include a cast-steel main slide, an all-steel turret, and a steel side-head slide. It is announced that these features will also be incorporated in the complete line of Bullard vertical turret lathes.



Bullard New Era 54-in. vertical turret lathe

The improved turret locking feature is made up of two steel rings screwed and doweled to the inner side of the turret and the face of the main slide. This construction provides five pairs of opposed bevel surfaces which mesh positively at the five points of turret registry. These rings are claimed to afford greater strength and accuracy, at the same time giving longer life. The all-steel construction of the turret and slide is intended also to increase the capacity of the machine for heavy cutting.

The side head has a vertical movement of 29-in. and a horizontal movement of 21-in. The head does not swivel. Quick hand movement in all directions is provided, as well as means for making fine adjustments independent of the feed works. A four-face turret tool-holder is carried on the side head.



All-steel turret head

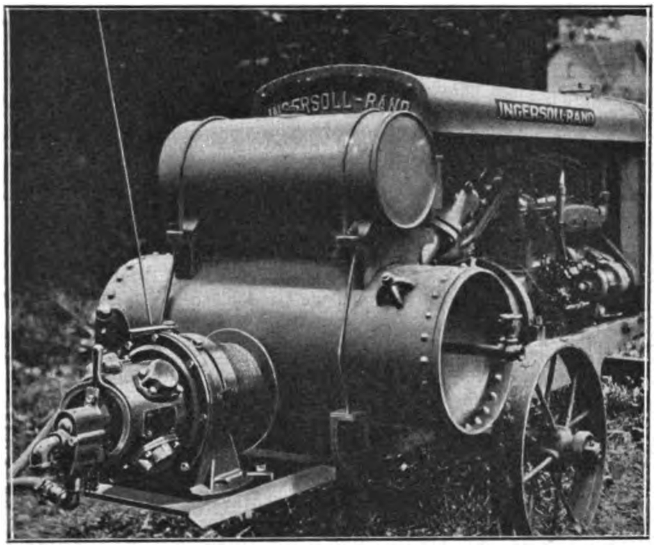
Special attention has been given to the lubrication of all working parts. An added feature of the machine is the adoption of pressure oil-gun lubrication for all bearings in the external units that are not reached by oil from the constant flow system or other unit reservoirs. An Alemite Zerk pressure oil gun is furnished as standard equipment with the machine.

The machine is intended either for countershaft or motor drive. When specified, the motor is fitted on a bracket at the rear of the machine and connected by a belt with the driving pulley. The net weight of the machine is 23,000 lb. No special foundation is required for the machine, which takes up a floor space 9 ft. 9 in. wide by 10 ft. deep. The total height of the machine, with the rail and slide in the highest position, is 10 ft. 9 in. The driving pulley is 24 in. in diameter and takes a 5-in. belt.

Riveters.—The Hanna Engineering Works, 1765 Elston avenue, Chicago, has issued a new catalogue descriptive of its compression and yoke riveters for boiler, tank, car, automotive and other industrial purposes. The various parts of the Hanna type riveter are shown in a full-page anatomical drawing.

Air hoist for use with portable air compressor

A NEW size DU utility air motor hoist has been developed by the Ingersoll-Rand Company, 11 Broadway, New York, which has been especially designed for use with portable compressors and is suitable for a wide variety of work. It is a hoist of general utility and is a suitable addition to any portable outfit.



Method of applying air hoist to a portable air compressor

It is a light, compact hoist of the winch type. It is provided with mountings by which it may be attached to the rear end of a 5½-in. by 5-in., or a 5-in. by 5-in. portable compressor, to the side of the larger compressors, or to compressors mounted on Ford trucks. In such cases it is always ready for use and adds but little to the overall dimensions and weight of the compressor. It is designed to exert a rope pull of 1,000 lb., and of taking 350 ft. of 5/16 in. cable. A swivel bolt through the bottom of the base permits the hoist to be swung around into any desired position.

The hoist is equipped with a clutch so that the cable can be easily played out by hand or by a down grade load without turning over the motor and consuming air. A hand brake on the drum is provided to check the unwinding and stop it in any desired position. The throttle control is sturdy and sensitive, so that any speed of rope travel can be obtained, from the very slightest movement up to a maximum speed of 65 ft. per min., although carrying a full load of 1,000 lb. at an air pressure of 80 lb. per sq. in.

A winch head can be furinshed in place of the rope drum.

The following are the principal dimensions of the DU motor: Capacity, 1,000 lb.; rope speed, 61 ft. per min. under load at 80 lb. air pressure; rope capacity, 350 ft., 5/16 in. diameter; width, 15 in.; length, 25⅜ in.; height, 19⅛ in.; net weight, 250 lb.

Rapid traverse side head 6-in. boring mill

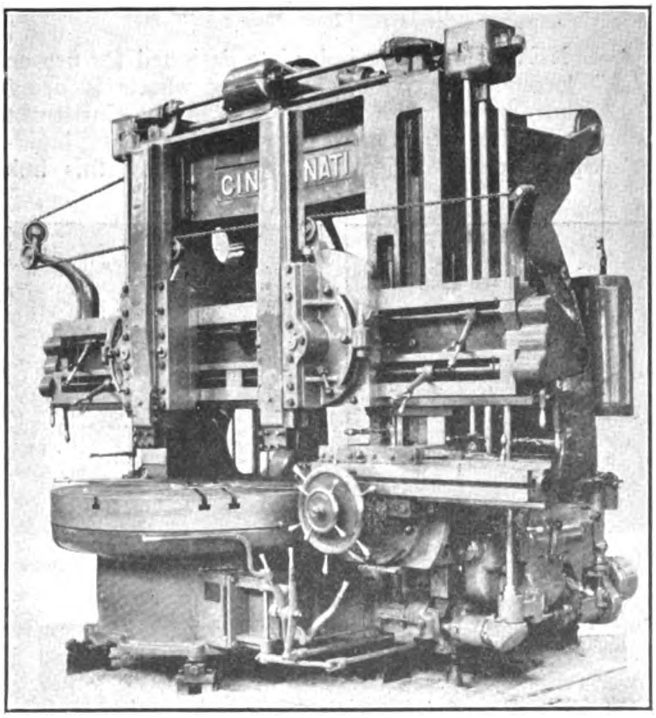
THE side head on the 6-in. boring mill, manufactured by the Cincinnati Planer Company, Cincinnati, O., has been designed to machine work of any height within the capacity of the mill. The ram and head construction permits a reach almost to the center of the table. The third head on the boring mill gives an opportunity to bore, face and turn at one time.

The feed box is placed on the side of the housing similar to that of the standard boring mill. Reverse of the feed can be obtained from gear boxes placed on either end of the feed box. The power feed can be used to feed the head up or down or feed the ram into the work.

The side head has a rapid power traverse in all directions, the power for which is obtained through an individual motor placed on the side of the housing. This motor is controlled with a drum type controller. Shifting of the lever connected to the controller changes the direction of the motor, giving rapid traverse up or down, or in and out. Throwing in the rapid power traverse lever automatically disengages the feed. The side head on the boring mill does not interfere with the use of the rapid traverse lever for the rail head and the levers for the side head are on the side of the machine in a convenient position.

The change levers for the table speed have been brought to the front of the machine in front of the side head. The start and stop levers have also been brought to the same position.

The construction of the housing and saddle is similar to that of the rail and saddle. The narrow guide has been embodied in the side head construction which eliminates twisting and other difficulties. The housing face has been considerably increased. This provides a strong, rigid housing and when securely bolted and dowelled to the bed, makes it possible to run the side head to the



All of the operating levers have been brought to the front of the machine for the convenience of the operator

extreme height and take large cuts. The ram, which is made of cast iron, has a steel rack bolted on it which provides an opportunity, in case of an accident, to replace the rail without throwing the entire ram away. Taper gibs are used throughout the head.

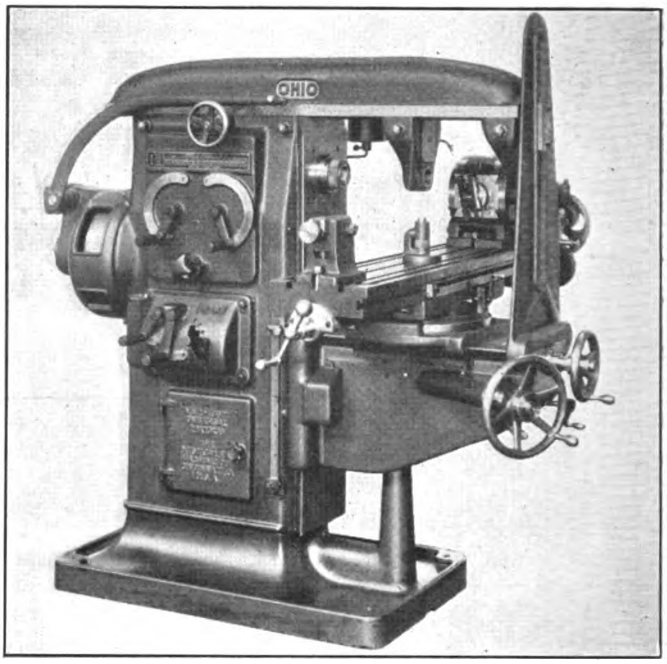
The side head can be provided with a crowning or taper attachment and, if necessary, also a thread cutting attachment. With these attachments it is possible to do any kind of work that would be placed on a boring mill in a railroad shop.

New Ohio milling machines

THE outstanding feature of the new Ohio constant speed or all geared milling machines, developed by the Oesterlein Machine Company, Cincinnati, Ohio, is the so-called Veeflat overarm. This is a heavy cast iron overarm of rectangular cross section, the name being derived from the vee and flat guides that form the bearing and provide alinement between the overarm and column. In addition to providing alinement of the arbor supports, this overarm forms a broad and rigid surface to receive the upward thrust of the cut. It is clamped by means of a pair of tee-slot bolts at the front and a pair at the rear of the column. Each pair equalizes and clamps by means of a nut at the side of the machine. The tee-slots in the overarm are placed as close to the vee and the flat contact surfaces as possible, so that the clamping pressure imposes no strain in the overarm or column.

The overarm is equipped with a rack that meshes with a pinion in the column. A handwheel is mounted on the end of the pinion shaft to provide a handy means of shifting the overarm. A feature of the overarm is the ease with which it may be handled for the replacement of arbors or cutters. The arbor supports may be placed on the arbor and the overarm slid forward into position by means of the handwheel.

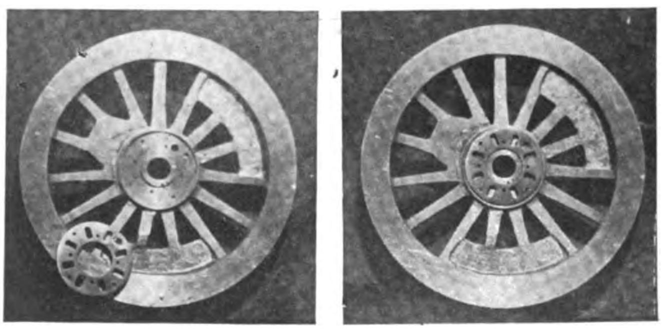
On both sides of the overarm are gaging strips. These are finished surfaces that are scraped parallel with the center line of the spindle.



A combination of el and flat surfaces is used in the design of the overarm on this milling machine

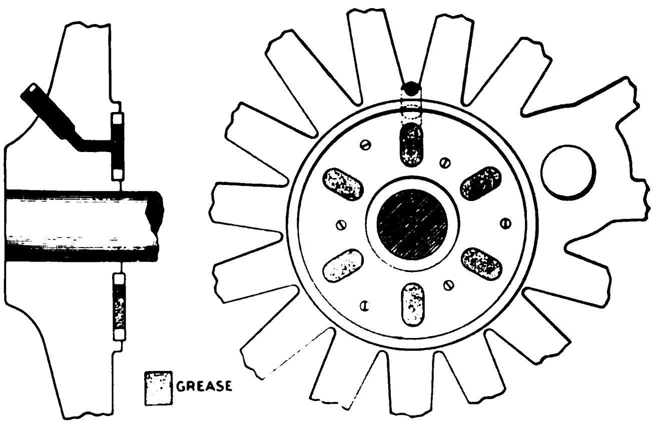
Lubricating hub plate reduces wear

A NEW lubricating hub plate designed for use on locomotive driving and trailer wheels is being introduced in the railroad field by the Christman Lubricating Hub Plate Company, 534 Landers building, Springfield, Mo. Work in developing this hub plate was begun a number of years ago and extensive tests on the St. Louis-San Francisco indicate that it lowers maintenance expense by permitting the operation of heavy power from shopping to shopping without taking up lateral play. It is being specified for all new power purchased by the Frisco and applications are made as present power passes through the shops for general repairs.



Christman lubricating hub plate before and after application

The Christman hub plate is little more than an ordinary hub plate with a special lubricating arrangement consisting of six elliptical holes through the plate to serve as grease pockets in conjunction with a grease plug hole in the hub for filling purposes. The hub plates



Method of applying the Christman lubricating hub plate

are finished all over and applied to new wheels before assembly on the axle. The location on the wheel center is such that one of the pockets of the hub plate coincides with the opening of the grease plug hole through the hub. The plate is held in place in accordance with the railroad's standard practice.

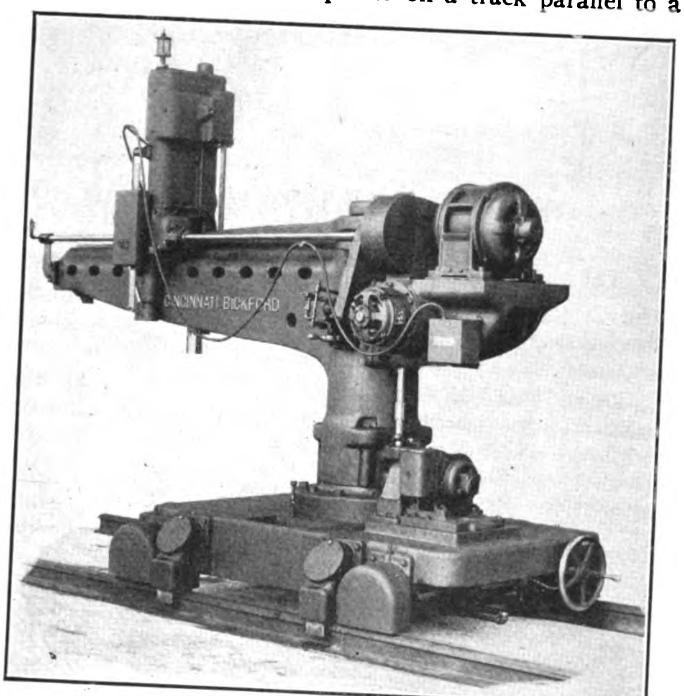
The exact location of the grease plug holes may vary somewhat with the pattern of the driving wheels, but it is important to locate them so that the grease plugs will at all times clear the side rods and when the engine is once spotted to have grease applied the grease plugs will be readily accessible on both sides of the engine. On most locomotives it is found that by locating the grease plugs as nearly as possible 90 deg. ahead of, or behind, the crank pins they will be readily accessible for removal and re-application in whatever position the locomotive is stopped. The grease plug holes should be such as to take the railroad's standard grease plug.

The Christman lubricating hub plate is applicable to locomotive trailer wheels in the same manner as to driving wheels except that it is not necessary to recess the hub of the wheel to receive the plate. The hub plate is simply fixed to the flat surface of the hub, the holes for lubrication being the same. These holes, as well as the grease cavity in the wheel hub, are filled with grease before application of the wheels under the locomotive thus assuring adequate lubrication at first while the plates are wearing to a smooth bearing against the hubs.

Multiple boiler plate drilling machine

The heavy type plate and rivet hole drilling machine shown in the accompanying illustration was especially designed for boiler, tank, and structural shops. It is particularly adapted for drilling holes in duplicate plates and on that class of work it offers a production that is rarely exceeded except by multiple punching where the entire plate is punched at one stroke or where a spacing table is used.

The machine consists of a special type of radial drill, having the base mounted on wheels and arranged for travelling under its own power on a track parallel to a bench or trestle on which the plates are stacked. The method of operation consists of stacking as many plates as the length of the twist drill will permit. A plate from a previously drilled lot is used as a template. While one stack is being drilled another is being set up on the other end of the bench. The bench should be long enough to support two stacks, end to end, of the longest plates which are to be drilled. When one stack is finished the operator runs the machine under power to the other stack and continues drilling.



The Cincinnati Bickford heavy type plate and rivet hole drilling machine equipped with an electric column binder for the arm and cutting lubricant outfit

The economies claimed as a result of the use of this equipment are that only one man is required to operate the machine—helpers are not needed; the usual labor gang is used only to stack the plates on the bench prior to drilling and to remove those which have been drilled. Laying out of holes is practically eliminated as a plate from a previously drilled lot serves as a template. Idle machine time is negligible for it occurs only when the machine is travelling between two stacks of plates. In erecting, further economies are realized. Reaming is almost entirely eliminated because the duplication of holes in the plates is perfect. Easier and better riveting results, because the sides of the holes are straight and not tapered as is the case in punched holes. Drill breakage rarely occurs because of the extreme rigidity of the machine.

Unusual consideration has been given to manipulation. The control levers have been so located that each movement required of the operator is performed through the shortest possible distance and with the least amount of effort. The arm swings under the pressure of one finger. The head has been carefully balanced on the arm so that it moves easily and swiftly. A large hand wheel on the right of the head moves it one and one-quarter inches per revolution. Lost motion has been provided in the head moving mechanism which gives a hammer blow effect for quickly alining the drill with the hole in the template.

The feed trip automatically disengages the power feed when the drill penetrates the bottom plate of the stack. It acts directly on the main feed clutch instead of disengaging an auxiliary jaw clutch as is commonly done. As a result two less movements are required of the operator for each hole drilled. This feature effects a decided saving in time between holes.

Electric or air arm-clamping equipment is furnished on special order. On the former the arm is clamped by means of a small motor; on the latter, by a double acting air cylinder. The control of both devices is located on the head near the spindle and is so arranged that the operator clamps and unclamps the arm without leaving his operating position at the head. Where only hand clamping is used the operator is required to make two trips from the head to the column for each hole drilled. The time and energy saved by the use of either the electric or air arm-clamping equipment is considerable.

A countersinking attachment can also be furnished if desired. It consists of a long lever attached to the feed pinion shaft, which provides a powerful lever feed to the spindle. With this attachment the operator can

position the head and arm with one hand and countersink with the other.

The frame of the machine is of unusually heavy construction. The arm is of box section and is integral with the column sleeve. The column is the rigid member upon which the arm swings. It is heavily ribbed and is secured to the base with a wide flange which has almost twice the thickness of the ordinary flange. An exceptionally large amount of clamping surface on the lower part of the column is positive assurance against any side movement of the arm while drilling. This is an important factor in preventing drill breakage.

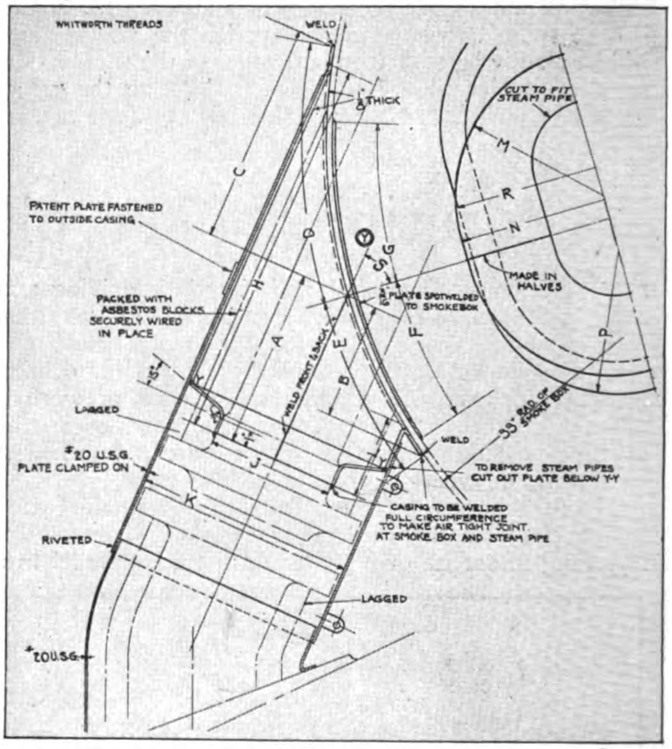
The base is strongly reinforced throughout with heavy flanged ribs. The machine is locked to the rails by four clamps located near the wheels. These clamps grip both sides of the rail head and are operated in unison by a large diameter hand wheel. An equalizing system insures uniform clamping. The wheels are of steel, machined and carbonized and are mounted on roller bearings. A two horse power motor, mounted on the base, furnishes power for propelling the machine on the track. It is geared direct to the axle through an enclosed worm drive and is controlled by a reversing drum type controller.

Speeds and feeds have been carefully selected. They are effectively graded to cover a wide range of drilling. A production of 800 11/16 inch diameter holes per hour in 1/4 inch plates has been obtained with this machine.

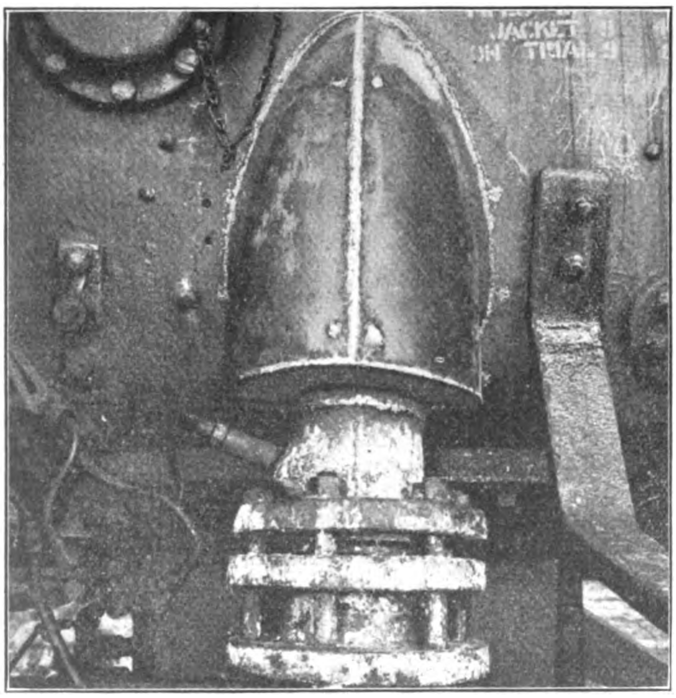
The machine is built in four sizes, having four, five, six, and seven foot arm lengths respectively. In addition to the heavy type plate and rivet hole driller the Cincinnati Bickford Tool Company, Cincinnati, Ohio, is prepared to furnish their standard radial drills mounted on the track type base.

Alco Flextite steam pipe casing

It is a difficult problem to make an airtight closure around the hole cut in the smokebox sheets where the steam pipes pass through. Exclusion of air from the smokebox is imperative as it is conducive to poor drafting, which results in increased fuel consumption. The American Locomotive Company, 30 Church street, New York, is now using and supplying a patented arrangement whereby the casing is welded to the outside of the smokebox and around the steam pipes. First the steam pipes are covered with asbestos blocks securely wired in place. Then the 1/8-in. split casing is bolted in place around the steam pipes. The seams in the casing are then



Method of laying out a casing for around a steam pipe



The Flexite steam pipe casing after the welding operation is completed

welded, it is welded to the smokebox and the lower end is welded to the steam pipe. There is sufficient flexibility in the casing to take care of the necessary expansion and contraction.

There is said to be a net saving in weight of approximately 80 lb. per locomotive and castings are eliminated, with attendant machine work and chipping. Properly welded, the casing will remain airtight indefinitely around the steam pipe.

The Railroad Labor Board has remanded to the parties in interest all pending disputes. At the time of the enactment of the new railroad labor legislation the Board's calendar had on it 426 dockets covering 468 disputes, 44 of which were of a general nature, affecting large groups of employees. Among the applications for wage increases were those of the Brotherhood of maintenance-of-way employees, affecting 31 roads. This case was heard last October, but decision had not been rendered. The Brotherhood of Railway and Steamship Clerks and 18 roads were involved in a pending application for wage increases upon which no hearing was held. Two cases involved request for wage increase by the Order of Railroad Telegraphers for the telegraphers on the Chicago, Burlington & Quincy and the Chicago Great Western. No decision had been rendered although the case was heard in September. The Brotherhood of Locomotive Firemen and Enginemen have requests for increases similar to those presented by the Order of Railway Conductors and the Brotherhood of Railroad Trainmen.

L. M. Parker, former secretary of the Labor Board, has been appointed custodian of the records of the Board and is in charge of closing up its affairs.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

The Boston & Maine announces that a joint board of labor adjustment has been established in the mechanical department to co-operate in the disposition of such grievances and disputes as may arise between management and men. This board will function along the lines followed by the board established jointly by the road and the brotherhood of clerks two years ago. A board of six members is created, three appointed by the association employees and three by the railroad, serving for terms of one year. Representatives of the association and of the railroad will alternate each six months in filling the positions of chairman and vice-chairman. Jurisdiction of the board is limited to disputes growing out of personal grieveances or out of interpretations or application of schedules or practices now in effect or hereafter established, and does not include proposed changes in rates of pay, rules or working conditions.

Safety Section circular No. 131

Of the casualties to railroad employees in the United States in 1925--1,599 killed and 119,224 injured—no less than 76 of the fatal and 589 of the non-fatal injuries happened to men who were not on duty. This is the main topic of Circular No. 131 which has been issued by the Committee on education, of the Safety section, A. R. A., embracing its program for the activities which it is desired shall be made the special business of the safety specialists on all railroads during the month of August. Riding on the side of a freight train to save a short walk is one of the more common occasions in which employees are injured when off duty; and the circular contains two pictures, one of which emphasizes the fact that many of these employees are those in the clerical service, with no possible excuse for endangering their lives on the railroad any more than would a school teacher or a clergyman.

Rock Island to motorize on branch and main line

The Chicago, Rock Island & Pacific has prepared plans for the use of gas-electric cars on some of its branch and main lines. The purchase of the first seven units in the program has been authorized and when installed they will be assigned to branch lines in Iowa and Oklahoma. The motive power to be used is of the gas-electric type, employing a petroleum distillate for fuel. The use of the new motor cars on the main lines will result in eliminating local stops for through trains and will materially speed up the through train service.

These new motor units will include double power plants and four motors of such design that either one or both power plants with corresponding motors can be used to meet the operation of heavy trains. The motors will be of 275 hp. each. One of the advantages to be secured through the proposed motorization program is that existing equipment can be converted into motor units by building the motors into the cars. The 45-ton steel Rock Island mail cars now in use on the regular trains are to be thus converted and be made available at once.

Wage statistics for April

The number of employees reported by Class I railroads to the Interstate Commerce Commission for the month of April, 1926, was 1,783,411, an increase of 37,997, or 2.2 per cent over the number reported for March, 1926. Owing to seasonal requirements, the number of employees in the maintenance of way group shows an increase of 44,107, but this number was slightly offset by reductions in the maintenance of equipment, and the transportation groups. The total compensation, $242,943,370, shows a decrease of $6,684,887, or 2.7 per cent. This decrease in compensation in the face of an increase in employment is explained by the fact that April had only 26 working days while March had 27. It is also noted that the principal increase in employment occured in the number of lower paid employees.

Compared with the returns for the corresponding month last year, the number of employees reported in April, 1926, increased 2.2 per cent, and the total compensation increased 3.5 per cent. As indicated in the subjoined table, the increase in employment appears largely in the maintenance of way, and the transportation groups. The difference between the percentage increase in employment and in compensation is due to slight increases in the number of hours worked per employee and in the average rates paid.

Court news

Cars Chained Together for Twin Loads Not Violation of Law.—The federal district court for southern Texas holds that the purpose of the Safety Appliance Act is remedial, to obtain safety, rather than penal, to exact retribution. Two cars which had moved as a twin load, having their coupling attachments disconnected and being chained in rigid fashion for safety, were being returned for repairs to the initial carrier, there being a repair track of the connecting carrier much nearer the place of unloading. It is held that there was no violation of Section 2 of the act. Either the two cars joined became one car, or the fundamental purpose of Section 2 to conserve the safety of the persons engaged in coupling and uncoupling the cars was not affected, since the cars were not to be and could not be coupled or uncoupled in ordinary railroad usage.—U. S. v. I.-G. N. 9 F. (2d) 142.

Failure to Comply with Boiler Inspection Act.—A conductor was riding in an engine cab when the main pin broke, punching a hole in the boiler. The men on the engine jumped to save their lives. In so doing, the conductor received fatal injuries. In an action for his death, under the Boiler Inspection Act, the Circuit Court of Appeals, Second Circuit, holds, Hough, C. J., dissenting, that the Boiler Inspection Act imposed an absolute duty on the railroad to have the engine boiler and its appurtenances safe to operate, making the railroad an insurer of the safety of the place in which the employee works and of the appliances with which he works. But it must appear that the railroad's failure to comply with the act was the proximate cause of the accident.—Lehigh Valley v. Beltz, 10 F. (2d), 74.

Meetings and Conventions

Southern and Southwestern Railway Club holds annual outing

The annual outing of the Southern and Southwestern Railway Club was held in Atlanta, Ga., Thursday, July 15. The forenoon was devoted to a business meeting. A. J. Law (master mechanic, N. C. & St. L.), president of the club, presided. Minutes of previous meeting were read and new members balloted upon. A. G. Pack, chief Bureau of Locomotive Inspection, was to have read a paper entitled, "The Advantages of Organization and the Maintenance of Motive Power," but he was unable to be present. His paper, however, will be printed in the next proceedings. The meeting adjourned promptly at noon and buses transported the members to a nearby park where an old-

fashioned barbecue was indulged in. Members also had the pleasure of visiting a house which is an exact replica of the old home of Robert Burns in Scotland. Every detail was complete, including the furnishings.

Fall meeting of the American Welding Society

The fall meeting of the American Welding Society will be held in Buffalo, November 17, 18 and 19. An international welding and cutting exposition will be held in connection with the meeting, which will open Tuesday afternoon, November 16. The technical sessions include railroad welding apparatus, welding science in the engineering curriculum of universities, and welding in a gaseous atmosphere. The entertainment includes a trip to Niagara Falls, a view of the Falls from the American side, with an inspection trip through the Niagara Falls power house, a buffet supper on the Canadian side and a special illumination of the Falls. There will be the usual annual fall banquet and a meeting of the American Bureau of Welding, the Board of Directors and the Welding Wire Specifications Committee.

Master Blacksmiths convene at Cleveland, August 17

The International Railroad Master Blacksmiths' Association will hold its thirtieth annual convention August 17, 18 and 19 at the Hotel Winton, Cleveland, Ohio. There will also be an exhibit held in conjunction with the convention under the auspices of the International Railroad Master Blacksmiths Supply Men's Association, of which James A. Murray, Ajax Manufacturing Company, is president. The program consists of committee reports on a total of ten subjects which are as follows: Autogenous Welding, A. W. Young (N. Y., N. H. & H.), chairman; Carbon and High Speed Steel, Frank P. Diessler (B. & L. E.), chairman; Drop and Machine Forging, C. C. Ferguson (N. P.), chairman; Drawbars and Drawbar Pins, C. D. Hayes (N. P.), chairman; Frame Making and Repairing, John P. Reid (M. P.), chairman; Heat Treatment of Steel and Iron, T. F. Buckley (D. L. & W.), chairman; Reclamation, H. Wright (P. M.), chairman; Spring Making and Repairing, J. B. Ray (M. P.), chairman; Safety First, J. J. Haggerty (N. Y. C.), chairman; and Tools and Formers, C. A. Wagner (N. Y. C.), chairman.

Tool Foremen to meet at Chicago

The fourteenth annual convention of the American Railway Tool Foremen's Association will be held at the Hotel Sherman, Chicago, September 1, 2 and 3. The program arranged for this meeting is as follows:

Wednesday, September 1

9:30 a. m. (Daylight Saving Time)

Address by L. A. Richardson, general superintendent of motive power, Chicago, Rock Island & Pacific.
Address by President E. A. Hildebrandt.
Report of secretary-treasurer.
Appointment of committees.
Unfinished business.
New business.

2 p. m.

Report of Standing Committee on New Labor-Saving Tools and Devices for the Air Brake Department, H. Otto, chairman.
Report of Standing Committee on Training of Men Suitable for Toolroom Work, J. J. Sheehan, chairman.

Thursday, September 2

9:30 a. m.

Address, "Simplification, a New Tool for the Tool Foreman," by Edwin W. Ely, assistant director, Department of Commerce.
Report of Standing Committee on Standardization of Present Special Boiler Taps, O. D. Kinsey, chairman.
Report of Standing Committee on New Tools and Safety Devices for the Car Department, G. Reichart, chairman.
Election of officers.
Special visit to exhibits.

Friday, September 3

9:30 a. m.

Report of Standing Committee on General Locomotive Shop Kinks and Devices, J. E. Carroll, chairman.
Report of Standardization Committee, E. J. McKernan, chairman.
Report of Committee on Auditing, Committee on Thanks, and other special committees.
Selection of place for annual convention.
Adjournment.

General Foremen's Association convention

The following program has been arranged for the annual convention of the International Railway General Foremen's Association, which will be held at the Hotel Sherman, Chicago, September 7 to 10, inclusive:

Tuesday, September 7

9:30 a. m.

Address of welcome by Mayor Dever.
Response by Pres. H. E. Warner.
Address, "The possibilities of the General Foremen's Association," by E. L. Woodward, western editor, *Railway Mechanical Engineer.*
Response, J. N. Chapman.
President Warner's address.
Report of secretary-treasurer.
Appointment of committees.

2 p. m.

Topic No. 1—Balancing shop sub-departments.
Locomotive department, E. F. McCarthy, chairman.
Car department, A. H. Keys, chairman.
Discussion.

Wednesday, September 8

9 a. m.

Address by L. C. Dickert, superintendent motive power, Central of Georgia.
Response, A. H. Keys.
Response, T. C. Gray, supervisor of apprentices, Missouri-Kansas-Texas.
Topic No. 2—Development of the mechanic, R. J. Farrington, chairman.
Discussion.

2 p. m.

Topic No. 3—Maintenance of refrigerator car, J. N. Chapman, chairman.
Discussion.
Election of officers.

Thursday, September 9

9 a. m.

Address by D. C. Curtis, chief purchasing officer, Chicago, Milwaukee & St. Paul.
Response, F. M. A'Hearn.
Topic No. 4—The general foremen's responsibility for material surplus or shortage, F. M. A'Hearn, chairman.
Discussion.

2 p. m.

Address by F. H. Becherer, assistant to mechanical superintendent, Boston & Maine.
Response, W. F. Lauer.
Topic No. 5—Developing railroad shop foreman, J. R. Leveridge, chairman.
Discussion.

Friday, September 10

9 a. m.

Address by M. A. Hall, superintendent machinery, Kansas City Southern.
Response, F. B. Harmon.
Topic No. 6—Modern shop equipment as a factor in increased production, H. W. Harter, chairman.
Discussion.
Reports of committees.
Unfinished business.
New business.
Adjournment.

Southeastern Air Brake Club meets at Atlanta

The second regular meeting of the Southeastern Air Brake Club was held on the roof garden of the Ansley Hotel, Atlanta, Ga., July 16. One hundred sixteen members and visitors were in attendance. A paper on the maintenance of passenger brakes was read by W. D. Herndon of the Jacksonville Terminal Company. This paper was discussed at some length, the discussion finally branching off to brake pipe leakage and proper lubrication of brake cylinders. It was the general opinion of the club members that just enough lubricant to properly lubricate the walls of the cylinders should be used. It was also brought out that improper clamping of pipes and pulling the hose apart were responsible for a major portion of brake pipe leakage. A. S. Benton of the Westinghouse Traction Brake Company also presented a paper on automotive brakes. Lantern slides were used to show the changes made in the U-12 Universal valve to incorporate the quick-service feature. T. W. Newburn of the Westinghouse Air Brake Company explained the changes necessary to convert the U-12 Universal valve to a U-12-B Universal valve. Fred W. Venton, assistant manager of the Crane Company, read a paper on pipe fittings, and J. H. Ainsworth, director of railroad sales of the A. M. Byers Company, read a paper on piping. These papers were turned over to the Recommended Practice Committee with a view of having them presented at the next convention of the Air Brake Association which is to be held at Washington, D. C., in May, 1927.

Summer outing of the New York Railroad Club

The New York Railroad Club held its third annual outing or mid-summer festival at the New York Athletic Club, Travers Island, and at the Winged Foot Golf Club, Mamaroneck, N. Y. on Thursday, July 8. A large number of those who attended motored to Travers Island and a special train on the New York, New Haven & Hartford left New York at noon. The Long Island Railroad Band played en route and headed the procession in the march from the station at Pelham Manor to Travers Island. A buffet luncheon and dinner were served at the clubhouse and the party returned to New York on a special train late in the evening.

Among the various forms of relaxation which were a part of the outing were a number of competitive sports in which prizes were awarded. These included a golf tournament at the Winged Foot Golf Club in the morning and a tennis tournament and track meet at Travers Island in the afternoon. A variety of prizes was offered in the golf tournament covering low gross, low net, "kickers" handicap, and others, the winners of prizes being as follows: Albert Hedley, Sterlip Press, Inc.; H. B. Weatherwax, vice-president, Delaware & Hudson Traction Lines; L. O. Smith, vice-president, Columbian Machine Works & Malleable Iron Co.; Elisha Lee, vice-president, Pennsylvania Railroad; Harry B. Doyle, Doyle, Kitchen & McCormick; Carl H. Beck, assistant eastern manager, Westinghouse Air Brake Company; J. D. McLean, W. A. Callison, W. W. Krider, T. L. Harrigan, J. Schneider, A. Schneider, S. P. Hull, Cupid R. Black, Richard Devans, J. J. Dunne.

Long Island employees won first places in all but one of the track events. The results of the track meet were as follows: 100-yd. dash won by K. Wildermuth, Long Island, 10⅖ sec.; 220-yd. dash won by E. O'Shea, Long Island, 24 sec.; 440-yd. dash won by E. Shotter, Long Island, 54 sec.; 880-yd. run won by O. Rosener, Long Island, 2 min., 3⅖ sec.; one-mile relay race for company teams, won by the Safety Car Heating & Lighting Company, with the Long Island second, and the Erie railroad relay team, third.

In the tennis tournament, the singles were won by E. A. Rudy, with C. P. Richenberg, runner-up, both of the Baltimore & Ohio. The doubles tournament was won by A. C. Home of the White Company and C. W. Squer of the Electric Railway Journal, the runner-up being A. A. Borgading of the American Car & Foundry, and W. B. Johnson of Ross F. Hayes. Other special features were swimming, quoits and a baseball game between Erie and New York Central teams which was won by the former with a score of eleven to three.

The quoit pitching contest was won by H. W. Mowery, American Abrasive Metal Company with Maxwell King, Atlantic Fruit Company, second.

J. S. Doyle, assistant general manager of the Interborough Rapid Transit Company, who was general chairman of the annual outing committee was unable to attend, due to the labor troubles on the Interborough.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners' Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 21-23, Book-Cadillac Hotel, Detroit, Mich.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention September 20-24, Municipal Pier, Chicago.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

Birmingham Car Foremen and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. Building.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway. Clearing Station, Chicago. Convention September 21, 22 and 23. Hotel Sherman, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

International Railway Fuel Association.—J. B. Hutchinson, 1809 Capital Ave., Omaha, Neb.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention September 7-10, Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month. Terminal Hotel Bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Robert P. Moiser has been appointed manager of foreign sales of the Morton Manufacturing Company, with headquarters at Chicago.

The Electro-Motive Company, Cleveland, Ohio, has opened an office in Room 1029, Peoples Gas building, Chicago, in charge of J. F. Sattley.

A. O. Norton, Inc., has opened an office at San Francisco, Calif., and will be directly represented by Harry H. Hale, who has charge of the Pacific coast territory.

H. W. Kidwell, formerly of the National Railway Appliance Company, is now covering the southern territory for L. O. Cameron, handling Dupont Company products.

B. M. Horter, formerly of the Philadelphia office of the Cutler-Hammer Manufacturing Company, has been appointed manager of the Boston office, to succeed J. M. Fernald, resigned.

William H. Payne, manager of the Portland branch of the Yates-American Machine Company, has been elected vice-president in charge of all operations, with headquarters at Beloit, Wis.

R. P. Kelley, assistant advertising manager of the Autocar Company, Ardmore, Pa., has resigned to become advertising manager of the Timken Roller Bearing Company, with headquarters at Canton, Ohio.

George E. Watts, formerly with the Duff Manufacturing Company, Pittsburgh, Pa., has joined the Timken-Detroit Axle Company, Detroit, Mich., as a railway representative, with his headquarters in Atlanta, Ga.

H. C. Vickerman, formerly with the Oil Well Supply Company, has joined the sales force of the Reading Iron Company, Reading, Pa. Mr. Vickerman will represent the company in California, with headquarters at Los Angeles, Cal.

Tom C. King, who has been identified for fifteen years with railroad sales, has organized the Railway Products Company, 908 First National Bank building, Pittsburgh, Pa., and will serve as its president. Mr. King was formerly connected with the Kilby Car & Foundry Company and the Anniston Steel Company, Anniston, Ala. Later he organized the National Forge Company at Anniston and served as its secretary and treasurer until the company's plant was moved to Louisville, Ky., when he was appointed vice-president, with headquarters at that city. In 1923 he became manager of railroad sales for the Pittsburgh Knife & Forge Company. The Railway Products Company handles all railroad sales for the Pittsburgh Knife & Forge Company and the Keystone Bronze Company, Pittsburgh; also handles sales for the Neely Nut & Bolt Company, Pittsburgh; Greenville Steel Car Company, Greenville, Pa.; W. H. Miner, and the Symington Company, in restricted territory and in special cases.

T. C. King

F. E. Case, who for many years has been in charge of the railway equipment engineering department, of the General Electric Company, Schenectady, N. Y., has had added to his duties the supervision of the railway motor and railway locomotive engineering departments.

Frank N. Grigg, who for a number of years has been southeastern representative of the Heywood-Wakefield Company, Wakefield, Mass., railway car seat department, has tended his resignation with the company to take effect September 1.

Charles E. Stone, assistant to the president of the Chain Belt Company, Milwaukee, Wis., has resigned to become vice-president and general manager of the Interstate Drop Forge Company. C. C. Brenner, controller of the latter company, has been elected secretary.

D. W. McGeorge has been appointed sales engineer of the Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., manufacturer of hydraulic presses, rolling mill machinery, steel castings, etc. Mr. McGeorge was previously connected with the sales department of the Edgewater Steel Company, Pittsburgh, Pa.

Grafton Greenough, vice-president of the Baldwin Locomotive Works, in charge of domestic sales, died on July 8 at the Hahnemann hospital, Philadelphia, Pa., after an illness of only a few days. He was in his sixtieth year. Mr. Greenough was a native of Philadelphia, and was educated in the public schools of that city. He served an apprenticeship in the plant of the I. P. Morris Company, Port Richmond, which later became part of the William Cramp & Sons Ship & Engine Building Company. His career with the Baldwin Locomotive Works started on December 28, 1885, when he entered the engineering department as a draftsman and designer. In August, 1899, he was transferred to the operating department, serving as assistant superintendent and plant engineer. At the time of the Louisiana Purchase Exposition in 1904, he was placed in charge of the St. Louis office, later assuming charge of the sales organization in Philadelphia as general sales manager. In September, 1917, he was appointed vice-president in charge of sales, and in March, 1919, when a separate foreign sales department was organized, his title was changed to vice president in charge of domestic sales. Mr. Greenough was national councilor of the American Chamber of Commerce of Mexico, and was a member of a number of clubs and several other organizations. In connection with his work in the sales department, he was a close student of locomotive design and took an active interest in the development of railroad motive power.

Grafton Greenough

The St. Louis Car Company, St. Louis, Mo., is constructing two additional units to its plant. One building, 1,000 ft. by 130 ft., will be used for steel fabricating and the construction of cars and will be equipped with four 10-ton cranes of 60-ft. span, while the second building, 100 ft. by 60 ft., will be used for housing light steel materials.

A. Milton Buck has joined the sales force of the Bridgeport Brass Company, Bridgeport, Conn. Mr. Buck will have his headquarters at Washington, D. C., and his territory will include Washington, D. C., the states of Maryland, Virginia and West Virginia. He will specialize on sales of Bridgeport-Keating flush valves and Plumrite brass pipe.

Charles W. Harris, of San Francisco, Cal., has been selected to build up a sales organization for the Dunn Painting Machine Company, of the same city. Robert S. Weintraub, formerly with the Weinstock-Nichols Company, San Francisco, has been appointed special representative for the Dunn Painting Machine Company, with headquarters at San Francisco.

L. F. Kuhman has been appointed vice-president and director of the Andrews-Bradshaw Company, Pittsburgh, Pa., sales man-

ager for the Tracyfier steam purifier and gas and vapor scrubber. Mr. Kuhman has been associated with the company for the past three and a half years, and prior to that time, he was for eight years sales engineer for the Ingersoll-Rand Company in the Pittsburgh district.

The C. A. Mauk Lumber Co., Toledo, Ohio, handling west coast and southern lumber, has established a new department, catering to the railroad and car shop trade, with H. J. Fletcher in charge. Mr. Fletcher was formerly sales-representative of the Germain Company, with headquarters in Chicago, and lately with the W. L. Shepherd Lumber Company, as sales-manager of its railroad and car material department.

Charles S. Orne has been appointed manager of the Central Steel & Supply Company, Railway Exchange building, Chicago, Ill. This company represents the Ross-Tacony Crucible Company, William F. Jobbins, Inc., Neely Nut & Bolt Company; Rockford Malleable Iron Works and the Riverside Iron Works. A. A. Orne has charge of casting sales and I. R. Robinson specializes on crucibles and stopper heads.

Arthur A. Helwig, representative of the Bradford Corporation, with headquarters at St. Louis, Mo., has been promoted to manager of the southwestern district, with the same headquarters, to succeed W. C. Doering, who has been elected vice-president, with headquarters in Chicago. George W. Bender, representative, with headquarters in Chicago, has been promoted to manager of the northwestern district, with headquarters at St. Paul, Minn.

Laurence Thompson has been appointed district manager of the Cleveland office of the United States Electrical Tool Company, with headquarters at 555 Erie building. Mr. Thompson was formerly Cleveland manager of Fairbanks Morse. Wm. J. McFarland has been placed in charge of the company's new Detroit offices at 2-226 General Motors building. The company has installed its own aluminum foundry at its Cincinnati Works and is now turning out its own aluminum castings for portable electric drills.

G. LaRue Masters, who for the past five and one half years has represented the car window equipment department of the National Lock Washer Company, Newark, N. J., in the east, has been placed in charge of the sales of this department for the entire United States and Canada, under the direction of J. Howard Horn, general sales manager of the company. Mr. Masters was born in Philadelphia, Pa., and was educated in the schools of East Orange, New Jersey. Previous to going with the National Lock Washer Company he was connected for 12 years with Unger Brothers, Newark, New Jersey.

A new company, which will be known as the Chromium Corporation of America, has been organized to take over the patents of the chromium plating process developed by the Chemical Treatment Company and the Chromium Products Corporation, the latter a subsidiary of the Metal & Thermit Corporation. This new company will have plants and branch offices in most of the leading industrial centers. John T. Pratt, president of the Chemical Treatment Company, will continue in that office and also be chairman of the board of the new corporation, of which Dr. F. H. Hirschland will be president. Dr. Hirschland is also president of the Metal & Thermit Corporation. Vice-presidents in charge of operations are Louis C. Owens, Jr., and Richard Loengard. Dr. Erich A. Beck is also a vice-president.

Clarence G. Stoll, general manager of manufacture of the Western Electric Company, has been elected a vice-president, with headquarters at New York to succeed H. F. Albright, deceased. Mr. Stoll was formerly manager of the Western Electric Hawthorne works in Chicago. He began work with the company 23 years ago as a student engineer in Chicago, and a few months later he was transferred to New York, where he spent some time in the switchboard wiring, tool inspection and engineering departments. His training won for him promotion to head of the apparatus department in New York. In 1907 he returned to Chicago to take charge of apparatus design work. In October of that year practically all apparatus designing was concentrated in New York, with Mr. Stoll as head of the enlarged organization. In 1908 he took over the engineer of methods department of the New York shops and three years later was promoted to acting head of the manufacturing branch, being placed in full charge in July, 1912. The following November he went to Europe to become shop superintendent of the Western Electric Antwerp factory. When the World War broke out, the Belgian factory was closed and in June, 1915, Mr. Stoll returned to America and took over the European automatic department at Hawthorne. In March, 1916, he became superintendent of the operating branch and in October of that year he was given the superintendency of the technical branch. He became assistant general superintendent of Hawthorne in 1920 and was put in charge of all departments at Hawthorne in February, 1923, with the title of works manager.

B. A. Clements has been elected president of the Rome Iron Mills, Inc., with office in New York, to succeed Edward Marshall Zehnder, who died on June 21. Mr. Clements was born in Indianapolis on October 3, 1877, and after attending the public schools of Centralia, Ill., he entered the service of the Illinois Central in 1891 as a messenger boy. He served in various capacities in the operating department until 1906, when he was appointed chief clerk to the operating vice-president. In 1909 he was appointed general agent, reporting to the president. The following year Mr. Clements left the service of the Illinois Central to go as western representative of the Worth Brothers Steel Company, with headquarters at Chicago. In April, 1916, Mr. Clements became vice-president of the Rome Iron Mills, Inc., and remained in this capacity until his election as president.

George Little Fowler

George L. Fowler, consulting mechanical engineer, writer and editor of literary and scientific subjects and a member of the staff of Railway and Locomotive Engineering for the past eight years, died on July 2, following an operation at the Brooklyn hospital, Brooklyn, N. Y.

Mr. Fowler was born at Cherry Valley, N. Y., on August 9, 1855. After his graduation from Amherst College in 1877, he entered the shops of the Miltmore Car Axle Company at Arlington, Vt., where he remained three years, becoming foreman of the shops. He then went to the New York Central as draftsman in the mechanical department, doing both car and locomotive work. He subsequently became chief draftsman of the Industrial Works, Bay City, Mich., manufacturers of excavators and traveling cranes. Later he was draftsman in the car and locomotive department of the Flint & Pere Marquette and was promoted to assistant master mechanic at East Saginaw, Mich. At this place he entered the employ of the A. F. Bartlett Company, manufacturers of sawmill machinery and steam engines, as superintendent. He then went to New York, and after doing some editorial work, served as superintendent of the Peckham Manufacturing Company at Kingston, N. Y., and afterwards became consulting engineer of the firm. Mr. Fowler then opened an office in New York as a consulting engineer and was engaged in this work for the past thirty years, specializing in research work in the field of locomotive design, construction and operation.

In 1887 he began contributing to the pages of the Railroad Gazette, of which the late M. N. Forney was then editor. Later Mr. Fowler became associate editor of that publication and the Journal of Railway Appliances. He was a contributing editor of the Railroad Age Gazette and the Railway Age almost continuously until 1919 when he joined the staff of Railway and Locomotive Engineering. Mr. Fowler was the compiler and editor of the 1906 and 1909 Locomotive Dictionaries. He is the author of The Car Wheel, Locomotive Breakdowns, Emergencies and Their Remedies, and the revision of Forney's Catechism of the Locomotive and compiled the indexes of the Proceedings of the American Railway Master Mechanics' Association and the Master Car Builders' Association.

He was a member of the American Society of Mechanical Engineers, and the American Electric Railway Association, serving on many of the important committees of these societies during the past 25 years.

Some achievements of his original work were the investigations regarding the qualities of steels used in steel tires and solid steel wheels, and the stresses in car wheels. He made the first investigation on the lateral stresses imposed on car and locomotive wheels while in service. He made investigations that resulted in cutting down of the mileage allowance of switching locomotives and conducted investigations of rolling resistances and the gyroscopic action of the motors on electric locomotives.

Mr. Fowler was a liberal contributor of writings, lectures and discussions to scientific, railroad and engineering organizations.

Personal Mention

General

M. D. STEWART has been appointed superintendent of motive power, Lines West, of the Southern, with headquarters at Cincinnati, Ohio.

J. M. PLASKITT has been appointed assistant to the superintendent of motive power, Lines West, of the Southern with headquarters at Cincinnati, Ohio.

S. J. WAGAR has been appointed engineer of tests of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding J. J. EWING, deceased.

ARTHUR C. PETERSON has been appointed master mechanic of the Stevens Point Division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Stevens Point, Wis., succeeding A. L. Fillmore.

Master Mechanics and Road Foremen

J. A. WILKING has been appointed master mechanic of the Southern at Ludlow, Ky.

H. E. DYKE has been appointed master mechanic of the Southern, with headquarters at Selma, Ala.

T. E. GARY has been appointed master mechanic of the Southern, with headquarters at Sheffield, Ala.

M. R. BROCKMAN has been appointed master mechanic of the Southern, with headquarters at Bristol, Va.

W. B. BUNN has been appointed master mechanic of the Southern, with headquarters at Chattanooga, Tenn.

L. C. SHULTS has been appointed master mechanic of the Southern, with headquarters at Somerset, Ky.

FRANK JOHNSON has been appointed master mechanic of the Southern, with headquarters at Princeton, Ind.

J. L. CANTWELL has been appointed master mechanic of the Southern, with headquarters at Spencer, N. C.

J. C. CAIN has been appointed assistant master mechanic of the Southern, with headquarters at Birmingham, Ala.

E. C. GORDON has been appointed road foreman of engines of the Toledo Division of the Pennsylvania, with headquarters at Toledo, Ohio.

C. B. KEISER has been appointed assistant road foreman of engines of the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio.

C. E. COLEMAN has been appointed assistant road foreman of engines of the Toledo division of the Pennsylvania, with headquarters at Columbus, Ohio.

LEWIS ARCHER has been appointed master mechanic of the Virginia division of the Seaboard Air Line, with headquarters at Raleigh, N. C., succeeding T. M. PRICE, deceased.

WILLIAM HOTZFIELD has been appointed master mechanic of the Duluth-Superior Division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Superior, Wis., succeeding W. F. Buscher.

M. R. REED has been appointed acting master mechanic of the Ft. Wayne division of the Pennsylvania, with headquarters at Ft. Wayne, Ind., succeeding O. C. WRIGHT, who has been granted leave of absence.

J. A. TSCHUOR, master mechanic of the Akron division of the Baltimore & Ohio, with headquarters at New Castle Junction, Pa., has been transferred to the Chicago division, with headquarters at Garrett, Ind., succeeding E. J. McSweeney.

E. J. MCSWEENEY has been appointed master mechanic of the Akron division of the Baltimore & Ohio, with headquarters at Akron, Ohio, succeeding J. A. Tschuor. The headquarters of the master mechanic of the Akron division were formerly at New Castle Junction, Pa.

Car Department

F. J. GIBSON has been appointed division car foreman of the Central of New Jersey, with headquarters at Elizabethport, N. J. Mr. Gibson's jurisdiction extends over the Central division east of Phillipsburg, N. J., and the Southern division.

Shop and Enginehouse

A. J. CRANDALL has been appointed locomotive foreman of the Canadian Pacific, with headquarters at Newport, Que.

G. KIRKCALDY has been promoted to night locomotive foreman of the Canadian Pacific, with headquarters at Farnham, Que.

E. F. O'CONNOR, formerly air brake instructor of the Southern at Finley shops, Birmingham, Ala., has been appointed general enginehouse foreman, with the same headquarters, succeeding J. C. Cain.

Purchases and Stores

J. L. HIGGINS, purchasing agent of the Kansas, Oklahoma & Gulf, with headquarters at Muskogee, Okla, has been appointed also purchasing agent of the Midland Valley.

E. V. PURDY has been appointed division storekeeper of the Southern Pacific Lines in Texas and Louisiana, with headquarters at Austin, Texas, a newly created position.

W. H. TAYLOR has been appointed reporting storekeeper of the Southern division of the Pennsylvania, and M. L. HENDERSON has been appointed storekeeper at Wilmington, Del.

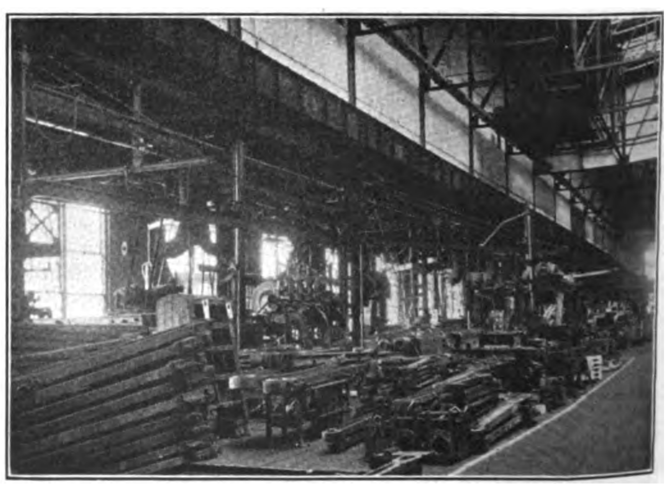
D. W. METZDORF, acting general storekeeper of the Alaska Railroad, has been appointed general storekeeper, with headquarters at Anchorage, Alaska, reporting to the general manager.

G. W. LEIGH, general storekeeper of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., has been promoted to assistant purchasing agent and general storekeeper, with the same headquarters, a newly created position.

W. J. KELLEHER, assistant to the president and purchasing agent of the Alabama & Vicksburg, with headquarters at New Orleans, La., has been appointed division storekeeper of the Illinois Central, with the same headquarters, succeeding I. S. FAIRCHILD, who has retired on a pension.

E. E. BASHFORD, vice-president and assistant treasurer of the National Railways of Mexico, with headquarters at New York. will hereafter attend to the purchasing department activities of that company in that city, which work formerly came under the jurisdiction of F. P. DE HOYOS, general agent, New York.

ARTHUR C. SIMMONS, who has been promoted to purchasing agent of the Chicago Great Western, with headquarters at Chicago, was born on January 1, 1890, at Chicago, and entered railway service in May, 1908, on the Chicago Great Western. His service has been continuous on that road, he having held various positions in the operating, engineering and purchasing departments.



Machine bay in the Angus Shops of the Canadian Pacific, Montreal, Que.

Railway Mechanical Engineer

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A new feature

Frequent reference has been made in the *Railway Mechanical Engineer* to the necessity on the part of those who are interested in improved leadership ability of keeping in touch with the latest and best thought on this question. One of the most significant developments of the period since the world war is the great interest which has been shown in matters dealing with better supervision and improved relations between managements and employees. Incidentally, this interest is clearly reflected in many ways, including stabilization of employment, improved working conditions and surroundings, greater efficiency and more economical production. A number of books have recently been published, or are in course of preparation, dealing with improved industrial relations, supervision, and things of that sort. Beginning with this number of the *Railway Mechanical Engineer,* it is the purpose, for a time at least, to publish regularly once a month a more or less extended review of one of these books, which we believe may be of special interest to our readers. The book discussed this month, "The New Leadership in Industry," is just off the press. An expression from our readers as to whether a feature of this sort will be helpful to them, with suggestions as to the particular classes of books which they would like to see covered in this way, will be appreciated.

Getting the "safety first" idea over

Carelessness and thoughtlessness on the part of employees in all industries are the two principal reasons why we hear so much about "safety first." The railroad industry has its share of negligent employees in whom must be firmly planted the idea of protecting not only their own interests, but also those of their fellow workmen. That satisfactory results in a safety campaign can be obtained in what is considered the most hazardous type of railroad shop was clearly explained in an article in the August issue of the *Railway Mechanical Engineer,* which described the methods whereby the total number of lost time accidents for 1925 were limited to 191 in the Enola steel freight car shop of the Pennsylvania System. It is true that the railroads of this country believe in educating their employees to the idea of self-protection. Committees have been appointed and intensive campaigns have been inaugurated, but the net results in many cases have not been entirely satisfactory. The underlying reason for these inadequate results is that the committee itself cannot put over a safety campaign in a particular shop unless the officer in charge of the shop is thoroughly sold to the idea of the safety movement. The foreman may placard his shop with catchy signs and clever sayings, but they will not register with the men unless they know that the "boss" is wholeheartedly behind the purpose of the signs and that he will "fire" any man who is persistently careless and negligent. If the officer in charge of the shop is a leader of men and understands human nature, he can make a safety campaign a complete success. On the other hand if he is not this type the success of the movement is doubtful, for his effort will be half-hearted and poorly suited to inspire a belief in the seriousness of the movement in the minds of the employees under his supervision.

Foremen's clubs

The survey of what has been done by the mechanical departments of the railroads to bring up the standards of supervision and improve the leadership ability of the officers and supervisors, which was published in the June number of the *Railway Mechanical Engineer,* has brought forth a number of inquiries as to the best form of organization of foremen's clubs and the subjects which can be considered to advantage by such clubs. The survey mentioned a number of railroads on which foremen's clubs have been organized and made some brief comment about the accomplishments of the clubs. A similar survey, published in the June, 1925, number of the *Railway Mechanical Engineer,* did go somewhat more thoroughly into the programs and procedure of a few of the clubs which were functioning at that time. To meet the needs of those who are now looking for more complete and specific information about such clubs, two articles will be found on other pages of this issue.

One of these, by J. M. Ganley, describes in some detail the form of organization and the programs which have been followed to excellent advantage by the Decatur, Ill., and Moberly, Mo., supervisors' clubs of the Wabash Railway. Another article, entitled "Making Foreman Training a Reality," by C. Y. Thomas, supervisor of apprentices of the Kansas City Southern, discusses the shortcomings of some of the foremen's clubs and makes definite recommendations not only as to the type of subjects which should be considered, but as to certain methods of procedure. It is obvious that Mr. Thomas is tremendously interested in making the work of these clubs more effective, because he has a vision of the wonderful possibilities which are involved. On the other hand, it is altogether likely that some of our readers will disagree with certain of his suggestions, such as having formal examinations and compulsory attendance. The fact must not be lost sight of, and this is said with no intention of minimizing the importance of the practical and helpful information which is developed at foremen's club meetings, that the get-together

feature of such clubs is one of their most important assets.

Will this be adversely affected by making the meetings too formal? Are examinations necessary? Are there less obnoxious but equally effective ways of checking up, or helping the class or club members to get the greatest amount of practical good from the organization? Will the supervisors profit more from a voluntary form of organization which is entirely conducted or promoted by themselves, as compared to a company-promoted type of class or club? Is something wrong with the supervisors when it becomes necessary to check them up and deal with them on the same basis as high school students?

These questions are asked with no idea of casting reflection on the splendid article by Mr. Thomas, which contains a number of most helpful suggestions, but rather to stimulate thinking and promote discussion on this question of improving leadership ability, which promises to be the most important development in the railway mechanical field in the months to come.

Why not attend the conventions?

The several organizations of railroad mechanical department supervisors including traveling engineers, railway general foremen, ~~master painters~~, master blacksmiths, chief interchange car inspectors and car foremen, tool foremen and steel treaters have prepared programs for their respective fall conventions, as shown elsewhere in this issue, which are practically without exception far ahead of any such previous attempts. Both in the calibre of the speakers obtained and quality of the reports to be presented, they are highly creditable to the association officers responsible. A tremendous amount of work in the aggregate is involved in preparing for these conventions, most of which is done by a faithful few among the officers and executive committee members. How far reaching will be the benefits, remains to be seen. Maximum results cannot be expected without a large attendance of members who actively participate in the meetings.

Many reasons can be devised for non-attendance at the conventions. Some traveling engineer, general foreman, car foreman or other supervisor may feel that he is too busy to get away. In some cases, the roads are unwilling to provide more than the transportation, and the supervisors feel that they cannot afford to go. In still other cases, the supervisors are just simply uninterested.

The answer to the first objection is that the supervisors who have not developed subordinates capable of carrying on their work for two or three days, or as long as the convention may last, have failed signally in the first important element of their task which is developing men. The answer to the second objection is that faithful and earnest supervisors pick up information at conventions which benefits their respective roads in amounts far exceeding the cost of sending them to the conventions. Supervisors who are not faithful and earnest should not be sent. Doubt in the minds of mechanical department heads regarding the value of convention attendance by subordinates can be solved by requiring individual reports which serve not only as a check on the supervisors attendance and keen attention at meetings but assist materially in crystalizing the ideas which he may pick up regarding new and desirable practices.

With regard to the third reason or explanation for non-attendance at conventions it cannot be gainsaid that the road whose mechanical department supervisors have no interest in meeting their fellows, exchanging ideas, and hearing about improved methods, is most unfortunate. The mechanical supervisory officers have this year developed programs which are constructive and instructive, exceeding in potential value, in many cases, any previously developed. The way for the railroads to capitalize fully on these conventions is to encourage a general attendance of the officers interested, require active participation, and insist on written reports as to information gained.

Steel Treaters' convention

The annual meeting of the American Society for Steel Treating, a program of which appears on another page of this issue, will be held this year at the Municipal Pier, Chicago, the week of September 20, bringing together again the greatest company of experts in the manufacture, treatment and use of steel in this country, if not in the world. In fact a considerable number of authorities from abroad will be present to read papers and participate in the discussions. As usual, a splendid display of various kinds of steel, steel treating equipment and methods will be available at the exhibit, enabling visitors to see the latest developments in the important art of steel handling. Railroad mechanical men should capitalize fully on the opportunity which attendance at this convention affords to increase their knowledge of steel and its proper treatment. Railroads have in the past adhered quite generally to the use of carbon steel and it is regrettable to have to say that many locomotive and car shops are not equipped for the proper treatment of carbon steel, to say nothing of the heat treatment of alloy steels so as to bring out the highly desirable properties of strength, relatively light weight, and wear resistance which they afford. Attendance at the convention will do much to show the improvements needed to bring steel handling practices in the average railroad shop up to modern standards. There will also be a large exhibit of machine tools under the auspices of the National Steel & Machine Tool Exposition which will warrant the attendance of all those interested in this class of railroad equipment. The impression is altogether too general, and there is altogether too much justification for it, that the average railroad shop is a back number, when it comes to treating steel. Why not get some wide awake mechanical department officers out to this convention and see what modern practices in the specification and treatment of steel lend themselves to railroad needs.

Employee representation

It became quite apparent to many people, even before the World War, that something was seriously wrong in the relations between employees and managements of industries in this country. Not a few expressed the belief that the interests of labor and capital were so far apart that they could never get together. On the other hand, there were some progressive leaders, at least, who believed that a wiser type of leadership could be developed on both sides, so that some way could be found of adjusting differences on the basis of the practical application of the Golden Rule. The World War, and the taking over of the operation of the railroads by the government, brought about the most unusual conditions in the railroad mechanical departments, so far as relations with employees were concerned. The problem was passed on to the managements when the railroads were returned to their owners and finally culminated in a catastrophe in July, 1922—the shop crafts strike.

Shortly after the war, many industries began to look

into the merits of employee representation as a means of bringing about better relations with the employees and promoting their mutual interests. The train service organizations on the Pennsylvania System worked out with the management a mutually satisfactory application of this idea, and prior to the shopmen's strike in 1922, the plan was carried over into the mechanical department of that system. Almost exactly four years ago, about September 1, several of the railroads which had refused to deal with the strikers and had built up new shop craft forces, turned to employee representation as the most logical means of dealing with these employees. Four years have elapsed since the new course was embarked upon and today both managements and employees on these roads are enthusiastic over the outcome. Never has there been such delightful and hearty co-operation and understanding.

Space will not permit going into details as to the results which have been accomplished or the differences in detail methods which have been followed on the various railroads. There has been a marked improvement in stability of employment. There has been a quite remarkable increase in efficiency because of the helpful suggestions from the workers and more prompt adjustment of misunderstandings, and there has been a great improvement in working conditions and surroundings. These things, indeed, have been characteristic of the successful application of employee representation to industries in general in this country.

Observers from abroad who have sought to find the reason for American industrial prosperity have returned home with glowing accounts of our industrial conditions. One of the things that has made a most pronounced impression is the application of the employee representation plan, which differs considerably from what has been done abroad. British industries, in particular, are apparently adopting the American plan. At least this impression is given by an article in the national American weekly newspaper, "Labor," in its August 21 issue. Considerable space is given to an article headed, "Company Unions Being Organized in Great Britain—Plan Imported from America since Collapse of the General Strike." The first paragraph of the article, which is dated London, August 15, reads thus: "'Mr. British Employer, meet Mr. American Company Union.' That is an introduction which is being busily pushed here. It is an interesting afterbirth of the general strike."

In commenting upon the extent to which the idea is spreading, in England, the statement is made, "Even the liberal Manchester Guardian, much the best paper in Britain, which is strongly pro-labor in industrial disputes and mildly so in politics, is engineering a company union." The article closes with the statement that the secretary of the Trades Union Congress "will welcome from American unions any special reports or other information on the wiles and failures of U. S. A. company unions encountered by them. Particularly, they are anxious to combat any accounts of 'successes' which may be advertised here by the coming U. S. A. company union propagandists."

Whether employee representation will work out as well in England with its rigid class system as it does in this country, with its broader opportunities and comparative lack of class distinctions, is a question. It must be remembered, also, that employee representation can be made a success only when a spirit of frankness and square dealing is religiously observed. The manager or employer who thinks he can utilize it to put something over on his employees or take advantage of them, has another guess coming. In other words, while it is important that the methods employed be based upon a few fundamental principles, the real thing that vitalizes the movement and makes it a success is the spirit behind it. This has been recognized on American railroads and in American industries, which have turned to employee representation in recent years, not as a panacea for all of their troubles, but as one means of bringing about better understandings and putting the relations between the employer and employee on a sound, logical basis.

New Books

THE ENGINEERING INDEX, 1925. *792 pages, 7 in. by 9½ in. Bound in cloth. Published by the American Society of Mechanical Engineers, 29 West 39th Street, New York. Price $7, to members $6.*

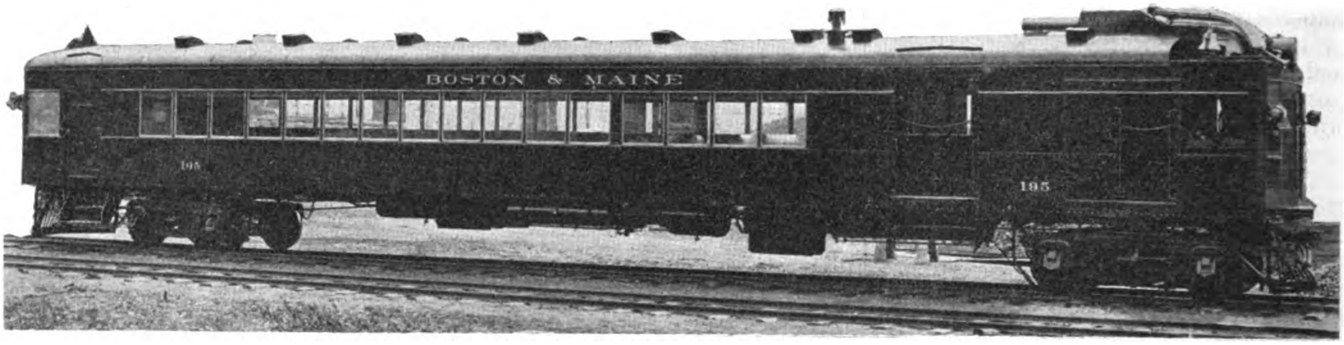
The Engineering Index published each year by the American Society of Mechanical Engineers has for years been considered a necessary reference book by those who wish to keep in touch with current engineering literature. It is always a welcome edition to an engineering library. Even those who have occasion to consult it only occasionally appreciate its value and completeness when they find it necessary to investigate any of the numerous subjects covered.

The first volume of the Index appeared in 1892 and it has been published annually since 1906. Up to 1918 it was prepared and published by the Engineering Magazine Company, but since that time by the American Society of Mechanical Engineers. This volume, numbering nearly 800 pages, includes some 18,000 items which appear in engineering and other technical publications and more than 3,000 of these items are cross-references. Many 1924 publications received too late for inclusion in the 1924 Engineering Index as well as periodicals in 1925, which were received as late as February 1, 1925, are included in this volume. In the preparation of the index, the staff of the society reviewed more than 1,200 periodicals, reports and other publications regularly received during the year by the Engineering Societies Library, New York. The railway field, both steam and electric, is covered.

THE METALLURGY OF ALUMINIUM AND ALUMINIUM ALLOYS. *By Robert J. Anderson, B. Sc., Met. E., Consulting metallurgical engineer. Bound in cloth, 6¼ in. by 9¼ in. 913 pages, illustrated. Published by Harry Carey Baird & Co., Inc., New York. Price $10.00 net.*

This volume is an entirely new work and is said to be the only complete modern volume written on this subject. It contains 19 chapters and nearly 300 illustrations, supplemented by tables and charts. While the book is written primarily with a view to being practical, the more theoretical aspects have not been neglected. The average layman will find the introductory and second chapters to be quite interesting. These chapters give a historical survey of the aluminium industry and an account of where the various aluminium ores are found and how they are mined. Chapter three goes into the various phases of aluminium production. The remaining chapters explain the various processes used in making aluminium alloys, their uses and applications, aluminium-alloy melting practice, foundry practice and allied subjects relative to fabrication, etc.

The volume is a thorough and comprehensive treatise on the metallurgy of aluminium and its light alloys, covering the subject from the mixing of the ores to the fabrication of the metal including its application and uses. The author is a well-known consulting metallurgical engineer and specialist on aluminium, whose experience covers many years in the industry.



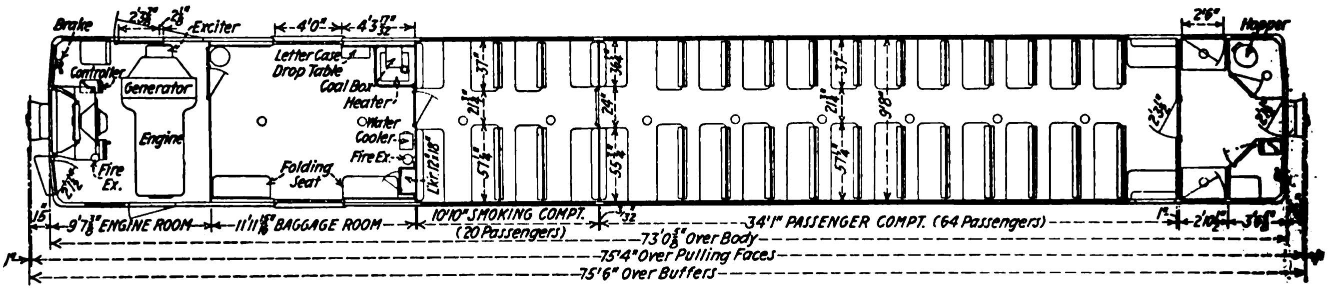
One of the 73-ft. rail motor cars built for the Boston & Maine by the Osgood Bradley Car Company.

Rail motor cars of all-steel construction

New equipment for Boston & Maine designed for long runs in main or branch line service

THE first car of an order of ten rail motor cars was recently delivered to the Boston & Maine by the Osgood-Bradley Car Company, Worcester, Mass. The complete delivery of this order will make a total of 24 rail motor cars in service on that road. All of the ten cars are identical in their equipment, details of construction and power plant, except that two cars have a length over the body of 73 ft. ⅝ in., while the remaining eight have a body length of 61 ft. ⅝ in. The 73-ft. cars are intended for service on runs where the traffic does not require the use of trailers. They are a complete passenger unit in themselves, having both passenger and smoking compartments in addition to baggage space, as shown in the drawing of the floor plan of this car. The 61-ft. cars, however, are designed for trailer service and nine standard coaches are now being prepared for this service, with the same features of interior color design, car heating equipment and seats, together with mail compartments, baggage space and other details which are necessary for self-contained train service. The passenger compartment in the 61-ft. motor car serves as a smoker when trailers are used. The new cars are to be used on various divisions of the Boston & Maine on runs each approximating 200 miles a day. One of these cars is to be operated on a schedule that requires a daily run of 350 miles. In some cases the new equipment will replace other motor cars which will be assigned to less important runs while several of the new rail motor cars will replace steam locomotive train service.

Both the 73-ft. and 61-ft. cars are equipped with the same type of power units and control apparatus. Owing to the fact that these cars are to be operated in main line traffic, the designers selected a power plant that would provide plenty of capacity to make a quick get-away from stations and also travel at a high rate of speed for short or long distances as required. Although the 73-ft. cars are not designed for trailer service, sufficient capacity is provided to handle trailers when the traffic makes it necessary.



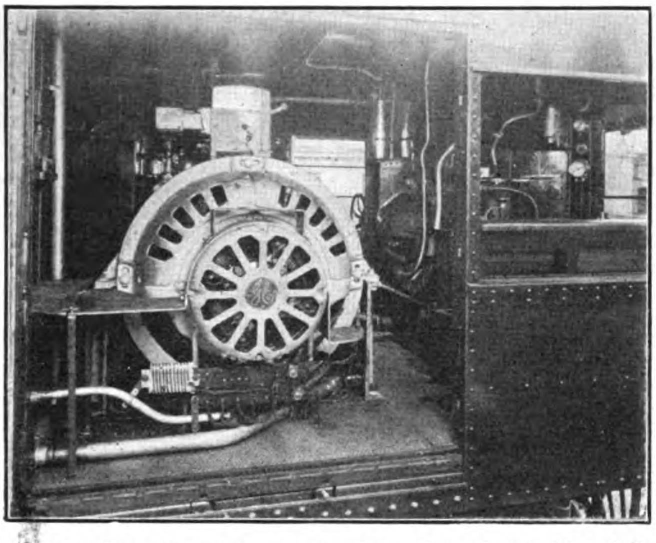
Floor plan of the 73-ft. rail motor car

Engine designed to operate on distillate

The power plant which was furnished by the Electro-Motive Company, Cleveland, Ohio, consists of a six-cylinder Winton gas engine which is designed to operate on a low grade fuel oil, such as distillate. The engine develops 275 hp. at 1,000 r.p.m. and has 7½-in. by 8½-in. cylinders. It is directly coupled to a General Electric direct-current generator which has an output of 180 kw. at 1,000 r.p.m. The engine and generator are mounted on a cast-steel bed plate secured to the underframe and is supported so as to minimize vibrations to the passenger compartment. Two dual ignition Bosch magnetos provide an ignition service of four plugs to each cylinder. Duff carburetors designed to handle low grade fuel

are applied on all ten cars. In case it is desired to use a higher grade fuel than distillate, such as gasoline, the only items that have to be changed are the carburetors and manifold. Provision has been made for starting the engine either by compressed air, electric starter, or by hand.

An interesting feature in the design of the power plant



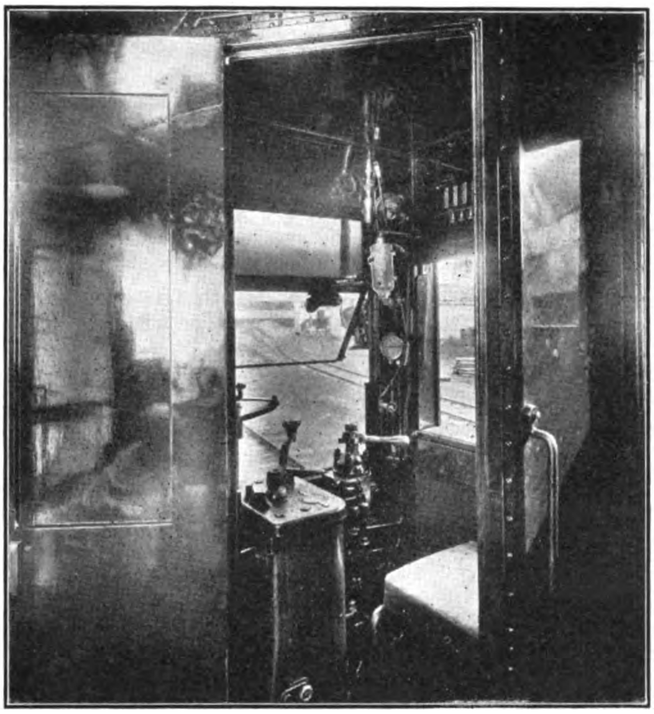
Looking into the engine room—A section of the side of the car can be removed which permits taking out the power units for repairs, if necessary

is that two radiators are employed for cooling. One of the radiators is of the automobile type and is located in the end of the car, as shown in one of the illustrations. The other radiator is located on the roof and consists

View of the front end of the 73-ft. car showing the location of the two radiators

of a series of pipes provided with fins to obtain increased radiation. A large fan draws air through the vents in the automobile type radiator and exhausts it through the radiator on the roof. Water in the radiator system, however, does not circulate through the roof unit unless the engine is running. This arrangement eliminates the possibility of the roof unit freezing up in cold weather while the car is standing idle. The hot water car heating system is also connected to the radiator system so that the end radiator can be kept warm in cold weather. This facilitates the starting of the engine, especially after it has been standing idle over night and also prevents freezing. In addition to these precautions for winter operation, a set of shutters are provided which can be fitted over the front of the end radiator.

The cars are equipped with Commonwealth cast-steel, four-wheel equalizer trucks. The motor truck has 5-in. by 9-in. journals and is equipped with special electric railway motors, self-ventilating, heavy-duty type, G.E. 254A, developing 154 hp. at 600 volts, mounted directly on the axles. The distance between wheel centers is 7 ft. The trailer truck has 4¼-in. by 8-in. journals with



Looking into the operator's cab—Both the 73-ft. and 61-ft. cars are equipped to operate from either end

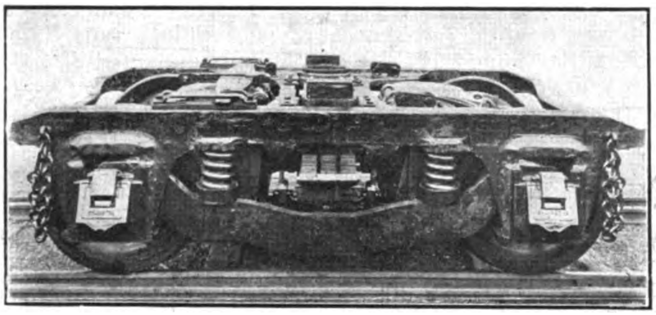
6 ft. between wheel centers. Both the 73-ft. and 61-ft. cars have 33-in. wheels.

The two 73-ft. cars are equipped with Areola heating units, while Peter Smith heating units are used on the eight 60-ft. cars. In both cases hot water is supplied to fin-type radiator pipes which are located near the floor along each side of the car in much the same manner as with the usual type piping. Approximately 5½ times as much radiation is obtained, however, with the fin-type piping as with the ordinary type. The hot water heating units are located in the baggage compartment, as shown in one of the illustrations.

Body design contains many unique features

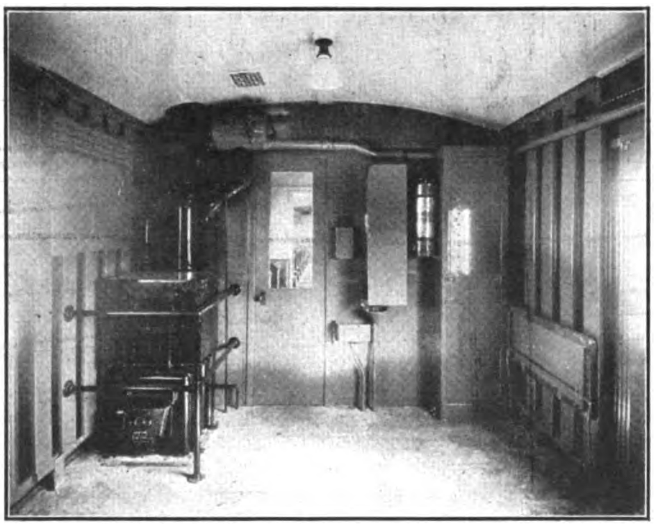
The body design of the 61-ft. cars is the same as that of the 73-ft. cars except that the passenger compartment is used entirely for smoker service and the seats are all finished in Pantasote. The inside width is 9 ft. 8 in. and the width over the eaves is 10 ft. The height from the rail to the crown of the roof is 12 ft. 2½ in. The passenger compartments have a row of seats on one side of the car seating three persons and a similar row seating two persons on the other side with a 21¾-in. aisle space

between. The toilet is located in the vestibule, as shown in the drawing, which provides additional privacy and also locates the hopper away from the trucks. The baggage room in both the 73-ft. and 61-ft. cars have the same general equipment, consisting of two folding seats, water cooler, locker for the crew, etc., the location of which in the 73-ft. car is shown in the drawing. The baggage room for the 61-ft car, however, has a total length of 16 ft. as compared with 12 ft. for the 73-ft. car. This additional space permits the installation of an extra folding seat in the baggage room of the 61-ft. car. As shown in one of the illustrations, the ceiling is



Side view of the motor truck

placed lower than is usually the case in passenger cars to give added efficiency in lighting and heating. The designers devoted considerable attention to making the interiors inviting to travelers. The use of narrow all-metal sash and small side posts has added much to the attractiveness of the car. This design provides an unusually large window area. The color scheme is a pleasing, leaf green enamel on the walls with the ceilings finished in light gray. The seats are of Heywood-Wakefield construction and in the rear passenger compartment are upholstered in plush dyed to a special tone of

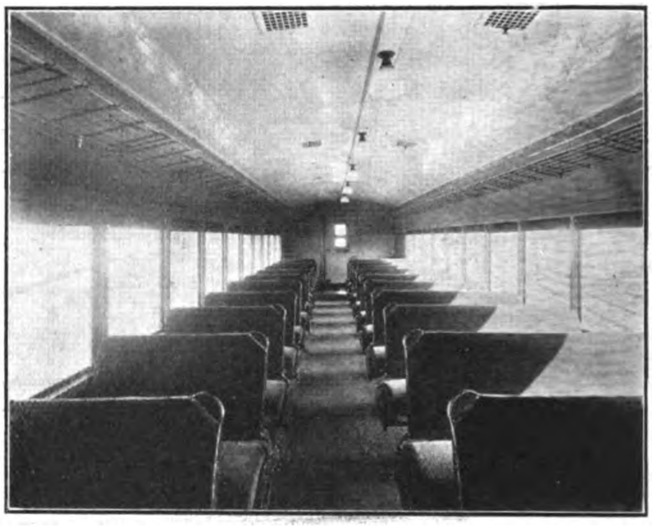


Interior of the baggage compartment of the 73-ft. car

green to harmonize with the general color scheme. Pantasote covering is used on the smoking compartment seats. The baggage compartments are finished in a deep buff color. Durelastic flooring is used throughout. Central ceiling lighting, using rigid pendant lights with white diffusing shades, is applied in all the new cars. These fixtures, together with the reflecting surface of gray on the low ceiling, produce a well distributed light. Special attention has been given to the ventilation of cars and all are equipped with a type of ventilator manufactured by the Osgood-Bradley Car Company.

Special equipment

Each end of both the 73-ft. and 61-ft. cars are equipped with locomotive-type steel pilots. Provision is also made for the attaching of a snow plow to the pilot for winter service. The air brake equipment, is the Westinghouse schedule A.A.M. with a braking ratio of 100 per cent at 50 lb. per sq. in. cylinder-pressure on the

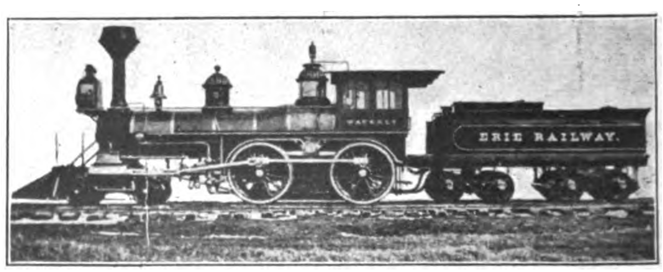


The wide windows and low ceiling of the passenger compartment add to the attractiveness of the car

motor truck and 90 per cent at 50 lb. per sq. in. cylinder-pressure on the trailer truck. Each car is also equipped with the Westinghouse pneumatic signal equipment for double-end operation. The fuel-oil tanks have a capacity of 200 gal. and are equipped with connections for filling on either side of the cars.

Comparative table of general dimensions and weights

	61 ft. car	73 ft. car
Railroad	Boston & Maine	
Builder	Osgood-Bradley Car Co.	
Length overall,	63 ft. 4 in.	75 ft. 4 in.
Length of body over end frame	61 ft.	73 ft.
Length of engine room	9 ft. 6 in.	9 ft. 6 in.
Length of baggage compartment	16 ft.	12 ft.
Length of passenger compartment	28 ft. 11 in.	34 ft. 1 in.
Length of smoking compartment	— — —	10 ft. 10 in.
Length of rear vestibule and cab	5 ft. 4½ in.	6 ft. 4½ in.
Width over side sills	9 ft. 10 in.	9 ft. 10 in.
Height overall	12 ft. 7 in.	12 ft. 7 in.
Height, rail to top of roof	12 ft. 2½ in.	12 ft. 2½ in.
Height, rail to top floor	4 ft. 4 in.	4 ft. 4 in.
Truck wheel base	6 ft. trailer 7 ft. motor	6 ft. trailer 7 ft. motor
Truck centers	43 ft. 6 in.	55 ft. 6 in.
Diameter of wheels	33 in.	33 in.
Seating capacity, passenger compartment	54 ft.	64 ft.
Seating capacity, baggage compartment	11	4
Seating capacity, smoking compartment	— — —	20
Total seating capacity	65	88
Engine, h.p.	275 h.p.	275 h.p.
Fuel	Distillate	Distillate
Total weight of power unit with appurtenances	30,000 lb.	30,000 lb.
Total weight (light)	90,000 lb.	100,000 lb.



Locomotive "Waverly," built for the Erie in 1870—Diameter of drivers, 60 in., cylinders 16 in. by 24 in.

The new leadership in industry*

The first of a series of discussions of books on improved supervision and better employee relations

TO PROPERLY appraise a book one must know something at least about the author—his training, experience, environment and personality. The title page of "The New Leadership in Industry" designates the author, Sam A. Lewisohn, as vice-president of the Miami Copper Company, and chairman of the board of the American Management Association. "Who's Who in America" characterizes Mr. Lewisohn as a capitalist, but it would also appear from his various connections that he is something of an economist and philanthropist as well. He also has some reputation as a writer and speaker on industrial relations and wage problems. Those who know him personally, however, are quite likely to think of him as a broad-minded, trained thinker, who has earnestly studied to improve the condition of workers in the organizations with which he has been associated. He has also made it a point to keep in touch with those leaders in industry who have had the courage and ability to leave the beaten path in the attempt to solve what has been designated as the industrial problem. Doubtless this is one of the reasons why he was drafted for such an important position in the American Management Association and why he has exerted so great an influence in the upbuilding of that association and the extension of its activities.

A reading of Mr. Lewisohn's book, which, by the way, is attractively printed in large type, must impress even those who have not come in contact with him personally, by the frank, open-minded way in which he approaches some of the troublesome questions associated with the question of employee relations. Incidentally, the book is not intended to be an exhaustive treatise on this subject.

"The real difficulty of labor relations," says Mr. Lewisohn, "has been one of neglect. Executives have treated the question of human organization as a minor matter, not as a major problem. They have too often failed to realize that their responsibilities as assemblers and organizers of man-power are just as great as those in mechanical and financial matters." Again, in discussing the responsibility of employers, Mr. Lewisohn says: "In industrial relations a great deal has been said of the necessity of co-operation between both sides, with the implication that the managers and managed are to an equal degree responsible for the outcome. The fact is that the responsibility for bringing about sound relations between employers and employees is not equally divided. trained thinker, who has earnestly studied to improve the industrial scene is the employer."

It is difficult to sum up or outline within our space limitations the author's approach to the problem and his suggestions for the new type of leadership. He starts out by calling attention to the fact that the relations between employers and employees have been "a football of our emotions," and emphasizes the importance of the application of sound reason and common sense to the problem. There are many misconceptions as to capitalism, and the author goes to some pains to indicate that the labor problem would exist in its essentials whether we have capitalism or some other economic system. We must clear our minds of such misconceptions if we are to make real progress in improving relationships.

In emphasizing the fact that executives are not automatons of capital, Mr. Lewisohn cites an example in the railway field as follows:

> "There is a prominent banking house which is interested in the Baltimore & Ohio. It is also interested in the Union Pacific. Both are very important systems. It would seem that the influence of this banking house should be similar in both railroads. But the railroads have radically different labor policies. The Baltimore & Ohio has introduced an interesting experiment in working out co-operation in the shops between union committees and managers. The Union Pacific has refused to treat with the unions and instituted an elaborate plan of employee representation. Bankers are more interested in results than in theories."

It is necessary to find and develop leaders with constructive qualities of leadership. This can be accomplished by removing certain obsessions and traditions from their minds, setting a new fashion in leadership and conceiving the training and development of leadership in broader terms. On this as a basis, Mr. Lewisohn discusses the education of the manager. His suggestions would in all likelihood start a spirited discussion in the railway field, because he draws attention to the fact that trained technical engineers are more and more being used as industrial executives, even though the average engineer is handicapped because of not having had a sufficiently broad training in industrial relations. The technical graduate, or any executive, however, even with the best of preliminary training, must continue his education in industrial relations on the job. A number of agencies are mentioned which are prepared to render assistance in various ways. Moreover, Mr. Lewisohn suggests that this country is so largely dependent upon industry that, "Continuous education of production managers to handle labor relations properly should be a general national educational policy."

Much consideration is given to the question of employee representation, with special emphasis on employee consultation. The functions of employee representation are outlined as follows:

> "(a) It enables the management to interpret itself to the men, and the men to interpret their aspirations to the management. (b) It serves as a vehicle for laying the facts of the business before the workmen and thus gives each workman the realization that he is being consulted. (c) It furnishes a method of discussing wages and hours with the employees as a group and coming to an agreement concerning them. Shop committees have proved very useful in wage and piecework adjustments. (d) It increases the sense of self-importance and responsibility of each workman, and creates a feeling of identification of himself with the plant organization. (e) It has great educational value in teaching the workers self-discipline. (f) It enables the management to utilize the practical knowledge and experience of the employees. (g) Properly supplemented by careful intensive education, it gives the employees a creative concern in their work."

In discussing the harmonizing of unionism and industrial effectiveness, the author pays a high tribute to the labor unions, at the same time pointing out the limitations of the unions.

The chapter on "The Modern Employers' Wage Policies" largely revolves around the question of the living

* "The New Leadership in Industry," by Sam A. Lewisohn. Published by E. P. Dutton & Co., New York. Bound in cloth, 229 pages, 5¼ in. by 7¾ in.

wage and the national income. Obviously, only those things which are actually produced can be distributed and the term living wage is more or less of a misnomer. Enough is not now being produced and the important thing is to discover and make effective those wage policies which will do most to increase the national productivity.

The closing chapter on "The New Leadership" indicates that in broad terms the more important desires of the workman are desire for justice, desire for status and desire to have his job made a career. Incidentally, the discussion of these involves, among other things, the question of employee and consumer ownership; in discussing the question of a career, reference is also made to the handicap which prevails on the railroads under union rules of seniority. Methods suggested for satisfying the desires of the workers and promoting better relations include the installation of a personnel or industrial relations department, improved management and efficiency and a rounded-out program.

"Producing a healthy human organization within industry is dependent upon no simple panacea," says Mr. Lewisohn. "Like health in real life, a continued daily regime suited to the needs of the particular individual is what counts in the long run. *With the adoption of scientific personnel methods and an interest in management technique, controversial aspects assume their correct place in the perspective. Production executives become organization conscious, instead of class conscious.*"

We have touched only upon some of the high points in Mr. Lewisohn's discussion. It is a thought-provoking treatise, which will prove stimulating to those who are interested in the problem of leadership. It may help to remove some misconceptions, and it will surely be an inspiration to further study of the question.

Economical method of handling engine supplies*

By G. E. Passage,

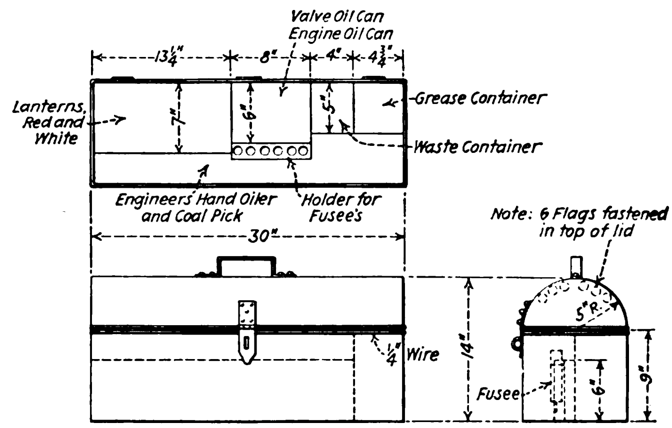
Division master mechanic, Chicago, Milwaukee & St. Paul, Terre Haute, Ind.

THE conservation of engine supplies has been given considerable thought by various railway officers. In order to reduce the cost of engine supplies, some plan or arrangement must be perfected to handle them economically, as at the present time the various supplies are stored in the different parts of the locomotive. The supplies should be kept together in a definite place.

One way of doing this is to provide and assign a supply box to the engineman as if it were his tool box, which would assist in keeping a closer check on the supplies. We now have a grease box applied on all locomotives and the engineman is in no way held accountable for the amount of grease used. Many times the pin grease is used on hot boxes and cars despite the fact that numerous instructions have been put out that such practice be discontinued.

At different times, we have tried to systematize the checking of engine supplies as the engines come in off the road. This did not prove at all satisfactory, as there invariably was some excuse from the engine crew as to what became of the missing supplies. Especially at large terminals, if checkers were provided and were confined exclusively to checking supplies, enginehouse expense would be increased and yet the desired results would not be obtained. Also, at small terminals, this would not be practical as the expense of assigning a supply checker to this operation exclusively would not be justified. The supplymen at small terminals are assigned to various other jobs. Where men have numerous duties to perform they are bound to overlook certain things and in this way we would not get the proper check on the supplies.

A supply box, shown in the accompanying illustration, is now used on the St. Paul for the purpose of keeping all the locomotive supplies confined to one place. In this box a space is provided for practically every supply that is used on a locomotive. When the locomotive arrives at the terminal the engineman is held responsible for seeing that all supplies are put away and the box locked. When the engine arrives at the oil house or the most convenient place near the supply room, the supplyman removes the box and checks the supplies, fills the lanterns, replenishes the waste and grease supply and locks the box. When the engine is ordered the supplyman places the amount of oil the engine is to receive, in the oil can provided in the supply box and again locks the box and places it on the engine. We are then in a position to check up the



A compact, portable, galvanized iron locomotive supply box

engineman and find out what he does with any supplies should there be any missing. A record should also be kept and posted each month showing the amount of supplies drawn by each engineman. In this way we will be able to show an enormous saving.

Lanterns and cans are ordinarily damaged more by the present method of handling them on locomotives than from the use they get. Many daylight trips are made during which the lanterns are not removed from the supply box.

The supply box will encourage an engineman to save a little oil for emergency use if he has a reserve can of his own. At the present time, he does not see the can which he had on the previous trip and naturally doesn't take much interest in the handling of lubricants.

The supply box arrangement should be used only on road locomotives. It would be a hard matter to handle supplies in this way on yard engines because the enginemen in some of our large terminals report for work in the yards. The yard power should be provided with a box that would remain on the engine.

* Abstract of a paper presented before a Supervisor's Club meeting held on the Chicago, Milwaukee & St. Paul.

Southern.—This company has awarded to Dwight P. Robinson & Co. a contract for the design and construction at Chattanooga, Tenn., of a complete locomotive terminal consisting of reinforced concrete roundhouse, machine shop, boiler, smith and tank shop, wash and locker buildings, storehouse, office and oil house, power house, necessary grading and miscellaneous yard structures.

Making foreman training a reality

Foremen's clubs should have carefully planned programs with definite objectives—Suggestions for topics and recommendations for procedure

By C. Y. Thomas

Supervisor of apprentices, Kansas City Southern, Pittsburg, Kan.

SUCCESSIVE years of intensified development of cars, locomotives and railroad equipment have brought to the fore the era of technical excellence. Our common hackneyed phrase describing the situation is, "The rule of the thumb is no more." Surely, though gradually, have the cruder "cut and dried" methods given way to the application of scientific methods. Frequently those who have an aversion toward studying, as well as those who are hesitant in taking up new ideas and methods, have found it necessary to become engrossed in technical phrases, terms and ideas. Popular approval of the radio has made commonplace such terms as microfarads, ohms and other terms which used to have a mystical significance. Similarly on the railroads, iron was iron and steel was steel, but now it is a charcoal iron, malleable iron, nickel steel, or chrome vanadium steel, all of which are generally understood and their quantities appreciated.

Because of the better application of the public school laws and the remarkable development of the educational system in this country, the railroads are being supplied with better educated employees. It is a fact, however, that most roads pay little attention to the practical education or instruction of these better educated employees. A few railroads have splendid systems for the training of apprentices in the mechanical department, but there the educational program stops.

The group of railway officials, such as master mechanics and shop superintendents, is composed of those who have fought their way up; all possessing some qualities which made them fitted for their positions. In practically every case the individuals have developed themselves without particular help on the part of the railway company. It cannot be denied that these men would be better men had they been given some sort of a systematic training while in lesser supervisory positions. In the higher positions they are constantly receiving a schooling through intimate contact with even higher officials of proven worth, whose suggestions and criticisms are of inestimable educational value; likewise contact between shop foremen and master mechanics is a schooling for the lesser supervisors but not in a way comparable to that above mentioned.

Master mechanics and shop superintendents are charged with a great responsibility in carrying out their work, and ordinarily cannot be intimately acquainted with all the minute details. It is the foreman who sees the little things which count so much in the conservation of materials and time and in the general efficiency. Thus the master mechanic's record varies directly with the ability of his supervisors. With so much responsibility resting upon the shoulders of the shop foremen, it is surprising that so little is done to help them to become better fitted for their positions.

The agencies provided by the railroads for the training of the supervisors are few. A very small group are sent to the various conventions for the purpose of keeping abreast of the times, a few railroads have regular supervisors' associations and a very few roads have what is known as foremen training classes. Much good is accomplished in the latter instances in getting the foremen together and letting them set up a forum of their own. In most cases interesting and instructive talks are made by qualified individuals but the question is, how are the roads to know that each foreman is making the most of the opportunities offered? Three out of four papers or talks will prove educational to about one-half of the listeners.

Many suggestions have been offered as to the subject matter for foremen's meetings, but in most cases there is no continuity of the subjects and no connection between them. Perhaps the greatest fault in the choice of subjects is that problems of immediate concern on the individual railroad are overlooked in favor of something of no particular worth or importance to them.

What real good is to come of foremen meetings when there is no definite or planned study program? The average shop foreman, who happens to be an officer in the club, is a busy individual in the shop and out, and as a result the programs of the meetings are usually mapped out along the lines of least resistance.

We can assume that foremanship training is needed in the railroad shops, but so far no systematized program has been offered. That this is necessary, if the maximum good is to be obtained from the meetings, is readily admitted.

High schools, colleges, correspondence schools and other educational agencies work on definite programs with definite goals of accomplishment. The work in each subject or course is outlined and planned through to the end, each unit of study following in proper sequence and dependent on what has gone before, but sufficient in itself. Then with the work planned, some method is used which will require individual effort. Time honored and proven custom is that of the written examination. To expect an individual to work and study on any project of perhaps no immediate benefit to him when he knows there will be no tests of the information he should have accumulated, makes for a group of disinterested class attendants. If the railroads are willing to leave it up to individual honesty to study, such as is the rule in most foremen clubs, why are not the engine and trainmen accorded the same privilege? Simply because written examinations assure individual effort and give the railroad officials a true line on the knowledge of the persons examined.

Subjects for foremen's meetings

The greatest difficulty in conducting any foremen training class or club, is that of selecting proper subjects for papers or discussions. This is true because of the fact that the average group of foremen will include those who have been promoted in from five to ten entirely different trades. Feed water heater maintenance

naturally does not concern the "rip track" foreman, nor is the coach foreman necessarily interested in arch tubes or flexible staybolts.

As far as his own work is concerned, a foreman who is on the job will be constantly studying all phases and developments and he should not selfishly desire the foremen's class to discuss his own highly specialized problems. No foremen's class should have the objective of making any foreman more expert in his own trade. That should be left to the individual and only those subjects of worth and interest to the entire group should be considered.

A book which would make an excellent text for a foreman's class is L. F. Loree's "Railroad Freight Transportation." A multitude of subjects are covered in this book which will provide subject matter for a class for a considerable length of time. This could be the background for lesson leaflets or outlines on the subject pursued.

Now for some of the subjects regarding which every foreman should have a definite and working knowledge:

A Brief History of the ———— Railroad.
Locomotives—Types, Designs, Utilization, Common Knowledge Points.
Freight Cars—Types, Design, Utilization, etc.
Train Yard Methods.
Freight Train Handling—Tonnage, etc.
Schedule Making for Freight and Passenger Trains.
Roundhouse Handling of Engines.
Repair Track Handling of Cars.
Locomotive Repairs—Classification, Costs, etc.
Freight Car Repairs—Classification, Costs, etc.
The Workings of the Stores Department.
Shop Accounting.
A Primer of Maintenance of Way Work.
Personnel Work.
Character Study—Handling of Men.

Such are a few of the subjects with which every foreman should be familiar and yet, commonplace as they are, they have no meaning in the average foreman's life or work. When a man understands something of the other fellow's work and can appreciate the difficulties in connection with it, there can be some sympathy for him and co-operation between department heads. Smoother operation of the railroad should be a fact rather than a desire, this being an objective of foremen training.

There are a number of things in the average foremen's club of today which subtract from the possible value of the meetings. The first of these is irregular attendance because attendance is usually not compulsory. It is a rarity when 100 per cent of the members attend and generally it is a visit from the superintendent of motive power or higher officer which accounts for it. Almost all foremen are on a monthly salary basis and where there is a hesitancy in attending meetings, it should be made a matter of compulsion. To require attendance at meetings when both the railroad and the individuals are to be helped is certainly not an arbitrary demand.

Another hindrance to good meetings is the custom of many members coming in late. There seems to be a general feeling that since the meeting is held outside of regular working hours, there is no necessity for punctuality. The disturbance caused by members coming late is always disconcerting.

After the papers are read, the discussions are often trivial because the foremen have not made a study of the subject. As a matter of fact, there is little incentive for a member to prepare a discussion, since so few are really interested in the paper. The average member does not enter into the discussions at length because he feels that he is encroaching on the personal liberties of the members by having them stay that much longer. So the meeting closes and although some good has been accomplished by getting the men together, little has really been done in a true educational way.

Suggestions for club procedure

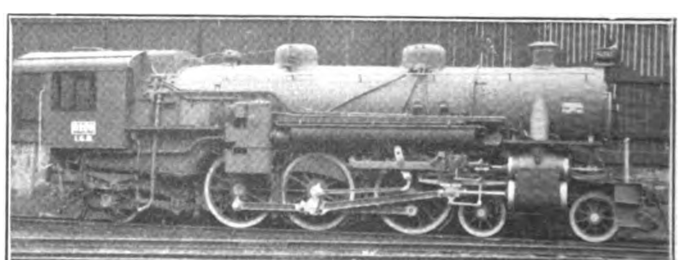
In contrast with the usual type of haphazard meeting, let us visualize a meeting of a real foremen's training class or club. The program for the entire year has been given out, suggesting reference books, etc. A mimeographed outline of the subject for each meeting should be given out a month in advance. The class leader calls the class to order promptly and the discussion is confined to an hour-and-a-half, the outline being prepared for that length of time. Each member has a note book and a loose leaf book for the preservation of pamphlets and notes handed out. Lessons are read or lectures given by picked men, entirely familiar with the subject. Meetings should be held on regular days, once or twice a month—written examinations every three months, followed by posting of grades.

With a carefully chosen list of subjects, everyone prepared on the subject at hand, examinations to show up individual effort, good meetings are assured and a twofold purpose is accomplished, first—facilitating the study of those interested; second—requiring a certain amount of study on the part of those who ordinarily do not enter into the spirit of the meetings.

Railroad shops as to machines, tools, materials and the like are becoming more systematized every day. Why not do a little towards systematizing the training of foremen? It is a fact that there is a scarcity of good supervising material. Almost without exception a master mechanic or shop superintendent cannot look about him without realizing that one or two of his supervisors should be relieved. Sympathy oftentimes is allowed to enter too greatly into consideration. Thus we find officials temporizing with situations and allowing incompetent supervisors to be moved up because of having no one ready for promotion. This is no doubt due to the fact than no effort is being made to train foremen to be better foremen.

Promotion to the top is slow at best, and particularly so when incompetent supervisors are kept on the job. Such conditions remove the incentive for a man to study and prepare himself for larger opportunities. With these conditions largely prevalent, and likely to continue, systematic foremen training could do much to remedy the evil.

In a class or club as described each railroad could prepare its own training courses, and do so with little extra effort. The possibilities of offering a broader training to the average intelligent group of foremen are too great to be overlooked. Keep them going forward instead of sliding back. There is a golden opportunity in the few hours spent at foremen's meetings and these hours should be intelligently used, making the foremen's club a real training club instead of a sandhouse gossip organization.



American built 4-6-2 locomotive for the Imperial Government Railways of Japan

T. E. A. convention at Chicago holds much promise

Arrangements have been made for a splendid lineup of speakers and reports at annual fall convention

THE Traveling Engineers' Association whose purpose is "to improve the locomotive engine service of American railroads" will meet in annual convention at the Hotel Sherman, Chicago, September 14 to 17, inclusive. Inspired by the initiative of President J. N. Clark (Southern Pacific) and aided by the long experience of Secretary W. O. Thompson, the officers of the association and committee chairmen have co-operated in preparing a program which, in the calibre of speakers obtained and general pertinent character of the subjects and reports presented, will set a new mark for this association, as well as others.

The first subject for consideration, "The Locomotive of Today" will partake more or less of the nature of a symposium at which Samuel O. Dunn, editor of the Railway Age, will preside and R. H. Aishton make the opening address. Among those who will speak on this subject of ever-present interest, as shown in the detailed program of the meeting which follows, are C. H. Markham, W. R. Scott, S. M. Vauclain, A. R. Ayers, W. L. Bean, A. G. Trumbull, and O. S. Jackson. These are names to conjure with in the railroad world and for those who desire to hear the symposium the wise course will be to get to the convention hall early, for standing room will, no doubt, be at a premium.

Other subjects and reports on the program are worthy of special mention, but, owing to space limitations, comments regarding them will be deferred until subsequent issues in the regular convention report.

J. N. Clark (Southern Pacific) President | J. B. Hurley (Wabash) 1st vice-pres. | J. D. Heyburn (St. L.-S. F.) 2nd vice-pres. | W. O. Thompson (N. Y. C.) Secretary

Convention program

Speakers:

- C. H. Markham, President, Illinois Central System
- W. R. Scott, President, Southern Pacific Lines
- S. M. Vauclain, President, Baldwin Locomotive Works
- A. R. Ayers, assistant general manager, N. Y. C. & St. L. Railroad.
- W. L. Bean, mechanical manager, N. Y., N. H. & H.
- A. G. Trumbull, chief mechanical engineer, Erie.
- O. S. Jackson, supt. M. P. & Mach., Union Pacific.

Subjects:

The Locomotive of Today
- Samuel O. Dunn, editor Railway Age, Chairman
- J. B. Ennis, vice-pres., American Locomotive Co.
- W. E. Woodward, vice-president, Lima Locomotive Works, Inc.
- C. T. Ripley, chief mechanical engineer, Santa Fe.

Smooth Train Handling
- Frederick Kerby, Baltimore & Ohio, Chairman

Practical Instructions for New Firemen in Combustion and Locomotive Operation
- M. A. Daly, Northern Pacific, Chairman

Booster
- J. A. Talty, Franklin Railway Supply Co., Chairman

Locomotive Availability in 100 per cent Condition Up-To-Date Roundhouse, Terminal Facilities and Modern Methods.
- P. O. Wood, Southern Pacific, Chairman

How Can the Traveling Engineer Cover His Growing Job?
- W. L. Hack, St. Louis-San Francisco, Chairman

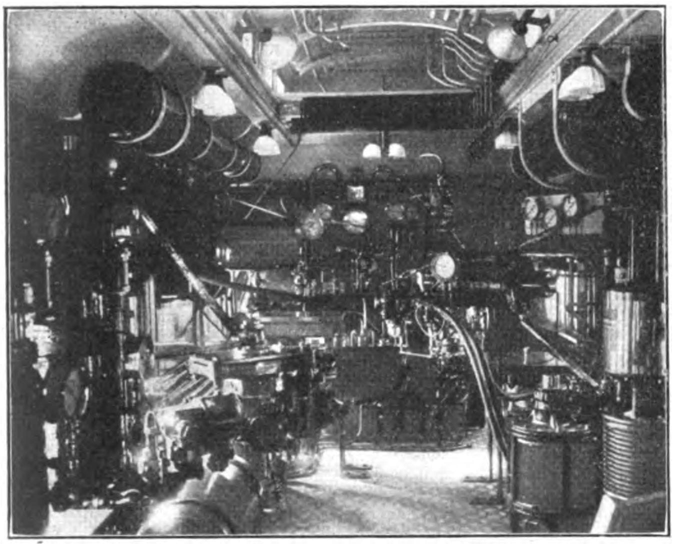
Automatic Train Control
- J. M. Nicholson, Atchison, Topeka & Santa Fe, Chairman

Revision of Progressive Examination for Firemen for Promotion and New Men for Employment.
- W. H. Corbett, Michigan Central, Chairman.

Missouri Pacific air brake instruction car

THE Missouri Pacific has recently completed and placed in service an air brake instruction car in which the arrangement of the equipment is quite unique. The car includes facilities for instruction in the maintenance and operation for both air brake and steam heat apparatus. The lecture end of the car has a seating capacity for a class of 35. The instruction end of the car is built to represent the boiler head in a locomotive cab. All the equipment in a locomotive cab is included in this arrangement so that the class looking at the arrangement of valves, etc., can easily visualize the relation of each piece of equipment as it is located in the cab of a locomotive. The injector, lubricator, water glass cocks, gage cocks, steam heat valve and sander valves are of sectional construction so that the observer can see the actual construction of each part and how it operates. A No. 6 distributing valve is suspended to one side and in front of the boiler head. This is a tandem valve having a sectional portion connected to the operating valve so that the operation of the piston, valves and various parts can be readily observed. The equipment for the No. 6 E-T, G-6-A, and S-W-A brake is installed so that it can be operated separately by the instructor. The tender brake and the U-C brake-cylinder are set in brackets on the floor so that the class can obtain an unobstructed view of the other equipment.

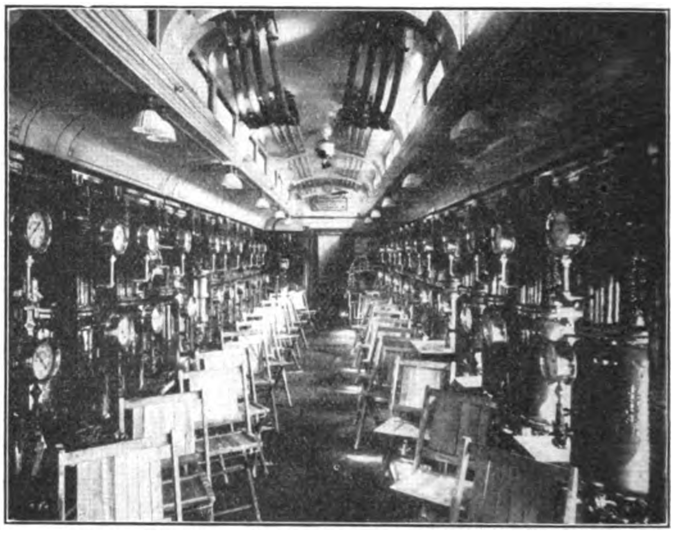
The braking equipment in the car consists of sets for 22 freight cars and 2 passenger cars in addition to the engine and tender brake, of standard size. Twenty one standard size freight brake-cylinders and auxiliary reservoirs are secured to the side of the car as shown in the illustration, 10 on one side and 11 on the other. This equipment is complete with retainers and release valves. Each cylinder and auxiliary is equipped with a pressure gage and the piston travel can be adjusted to various lengths from 4 in. to 11 in. A K1 triple valve and reservoir is mounted on a swinging crane which can be swung out in front of the class when desired. The crane locks against the side of the car when not being used for demonstration purposes. The car is also equipped with a six-car passenger train signal equipment, a complete vapor thermostatic heating system and a set of charts which are illuminated by a spot light.



The instruction end of the car is built to represent the boiler head in a locomotive cab

In addition to the instruction room there is a state room in one end of the car equipped with upper and lower berths, wardrobes, lavatory and shower bath. A complete kitchen with range, hot and cold water, lockers, ice box, and also an office equipped with an upper and lower berth, roll top desk, drop table and office files occupy the opposite end of the car.

The instruction room of the car is finished with mahogany to the top of the windows, the deck and ceiling being finished in a light gray. The air brake equipment is painted in standard colors for indicating the different pressures. The office and state room is also finished in mahogany and is equipped with golden oak furniture.



Interior view of the class room

The kitchen, lavatory and bath are finished in whit enamel. The inside length of the car is 62 ft. 10 in. and the total weight is 140,600 lb.

Three classes are held a day, at 9:30 a.m., 2:30 and 7:30 p.m. The superintendent and the master mechanic of each division is informed as to the time the car will be at the different terminals in their territory and they in turn bulletin the classes, requesting that all employees whose duties require them to be familiar with the maintenance and operation of air brake and steam heat equipment visit the car for instruction. Employees attending the classes are required to register and each master mechanic and superintendent is furnished with a list of the employees who visited the car. This list also shows the occupation of those who registered. If any condition arises in which a man shows that he is not as familiar with the maintenance and operation of the equipment as he should be, the attendance list of the car is referred to and if it shows that the man has not visited the car as often as he should, he is instructed to visit the car for further education, and show by his work that he is competent to remain in his present position.

The classes in the car are largely attended and are being handled by district supervisor of air brakes, George Leather and district supervisor of air brakes, L. E. Giffen. These men take turns in handling the car, relieving each other in monthly periods. With this system the car is in the care of a competent instructor at all times who is acquainted with the men and has their co-operation and confidence. By taking turns in handling the car the work does not become as tedious and monotonous as it would if one man were assigned constantly to the car.

Supervisors' clubs on the Wabash

How they are organized and conducted—Some of the more important topics discussed, with observations as to beneficial results

*By J. M. Ganley**

THE Wabash Mechanical Department Supervisors' Club was organized in March, 1923, at Decatur, Ill., the main mechanical department point on the system. A few months later a similar organization was formed at Moberly, Mo., the second largest mechanical department shop and car repair yard. All foremen, lead mechanics, general foremen, supervising officers, chief clerks, road foremen of engines, and fuel supervisors in the mechanical department, and storekeepers and store department foremen and chief clerks are eligible for membership. The purpose of the club is to cultivate and foster good fellowship among the supervisory forces of the Wabash Railway, and to discuss, formulate, and execute plans which will have in view the mutual benefit of both the members and the company.

The officers, consisting of president, vice-president, secretary, treasurer, and a board of five directors, are elected by ballot annually. Regular meetings are held at Decatur on the fourth Saturday of each month, beginning at 8 p. m., in a downtown hall rented by the club.

Some of the topics discussed

At each regular meeting an effort is made to have a paper read on some topic of interest to all the members. One of the first papers presented was on the stripping of engines, by the stripping foreman from the locomotive shop. It brought out many facts that were instructive. As a direct result of this paper and the discussion which followed, instructions were issued by the superintendent of motive power to all engine terminals on the system that work reports covering the major jobs on the locomotives were to precede the locomotive to the shop at least thirty days. This gives the shop people ample opportunity to line up their work and the storekeeper time to order the major items of material that will be necessary. Another beneficial result was the issuance of instructions that, under no circumstances, were locomotives to be "robbed" of parts before being sent to the shop; that is, no parts or appurtenances were to be removed from a locomotive to apply to some other locotive. While it had been customary for years to send in work reports on locomotives coming to the shop, the result of this meeting set a positive date and outlined a definite policy. In the case of robbing locomotives it brought this forcibly to the attention of those concerned that it broke up a practice that, while not being indulged in generally, was being practised at some places.

The material question

A paper on shop efficiency was prepared and read by a car shop machine foreman; it brought out many constructive thoughts and called attention to some poor practices.

At many meetings the material question was brought up and discussed at length. The stores department, naturally, received a lot of criticism. However, these discussions on material certainly had a good effect and resulted in a big improvement in the material situation. As a direct result of these arguments, the division storekeeper prepared and read, at one of the meetings, an interesting and instructive paper entitled "Exchange of Ideas," in which he outlined some of the difficulties of his department and showed where the mechanical department could help him, and in that way help themselves by having an ample supply of material on hand. Just how far the results of the division storekeeper's "Exchange of Ideas" went is practically impossible to determine, but it is safe to say that it directly resulted in a better feeling and a clearer understanding of some of the reasons why material is not always on hand the instant it is needed. A suggestion was made by the storekeeper that a form be prepared and printed, to be filled in by each master mechanic ninety days before the locomotive is due for shopping, this form to show the major items of material that the locomotive will require when shopped, such as tires, wheel centers, frames, cylinders, and a number of other parts. This form and practice were inaugurated and are working now with excellent success. This method allows the storekeeper to order the big items and the shop superintendent to have many of them machined before the locomotive is sent to the shop.

Safety and other matters

The safety inspector, who goes to every shop and station on the railroad, read a paper on safety. This paper, no doubt, has contributed a great deal to the wonderful improvement in the safety work on the Wabash. His subject was a live one and close to the minds of everyone who heard him and its lessons went home.

One of the road foremen of engines adopted as a title for his paper "Mechanical Department Conditions on the Road." He brought to the minds of the shop foremen a good many things that they, as shop men, possibly did not realize.

"Safety and Economy in the Use of Electric Current"—this paper was prepared by the electrical engineer. The facts and figures he offered were astonishing, and his suggestions for economy in the use of current could not help but result in economy and greater efficiency in shop operation; also in doing away with the unnecessary and extravagant waste incident to burning lights and allowing machines to run idle when not needed.

The chief draftsman of the mechanical department chose for his topic "Castings, Blueprints, and Patterns." He gave many facts about castings being too weak or unnecessarily strong in certain places. The information he furnished about blueprints, how they should be filed and cared for, and the expense involved in making them was very pointed. In the discussion that followed it developed that in one shop entirely too much metal was being wasted in borings and turnings, particularly on

* Mr. Ganley is now chief clerk to the assistant general passenger agent, but was employed as secretary to the superintendent of motive power at Decatur, Ill., during the greater part of the development of the supervisors' clubs.

brass castings. This was followed up and many castings changed so that this excessive metal would not be purchased.

The assistant to the traffic manager spoke at one meeting on the traffic situation and offered timely suggestions as to how each employee could help the business of the company. He also stressed the importance of courtesy to the traveling and shipping public.

The scrap dock foreman's paper told of many seemingly criminal cases of good and usable material coming to the scrap dock. At many of the meetings the subject of scrap and reclamation was discussed. A committee was appointed to look after usable material in the scrap pile and to make weekly trips, in a body, as a committee. Those serving on this committee are the general car foreman, assistant general car foreman, freight foreman and blacksmith foreman representing the car department; general foreman, assistant general foreman, gang foreman and blacksmith foreman from the locomotive department (back shop); superintendent scrap and reclamation, scrap dock foreman, locomotive storekeeper, and division storekeeper for the stores department; and the general roundhouse foreman. The immediate results of the work of this committee were astounding in the number of items saved and the members of this committee went back to their respective shops and took drastic measures to stop the waste of good and usable material.

"Correspondence" was the title of a paper prepared and presented by a man from the office of the superintendent of motive power, in which he endeavored to point out the importance of writing in such a way that written thoughts would convey the meaning intended; he called attention to many outworn and high-sounding phrases that have no place in modern business methods. He also pointed out some short cuts in railroad correspondence, and offered a number of suggestions.

Many other interesting and instructive papers dealing with subjects in which the members are interested were read and discussed; for instance, a fuel supervisor's paper called attention to the importance of setting valves on locomotives properly, air leaks in yards, on cars, and around the shop, all of which result in the consumption of more coal; the superintendent of air brakes spoke on air on locomotives, cars, and in yards.

At Moberly the Supervisors' Club is conducted along the same lines as the club at Decatur and many interesting and constructive papers have been read at its meetings, among them being such subjects as the following:

Cleaning and painting engines and cars, by a painter foreman.

Engine tank and freight car trucks, their inspection and maintenance, by a freight car foreman.

Maintenance and operation of locomotive air compressors, by a gang foreman.

The maintenance of locomotives and tenders in compliance with federal requirements, by the general roundhouse foreman.

The supervisor, by a general foreman from a small terminal.

What is required by economically handling machine work at the locomotive shop, by a machine foreman.

Handling of scrap material, by the labor foreman.

†Engine failures, their cause, and how to prevent them, by a road foreman of engines.

Requirements to economically prepare for use freight car, passenger car and engine truck wheels, by a mill machine foreman.

Items of interest to locomotive and car department as noted by a road foreman while in and away from his home terminal.

Slid flat wheels, causes of this damage, proper maintenance and operation, practice to follow to reduce slid flat wheels to a minimum, by a coach foreman.

Suggestions of requirements from the home terminal to assist in obtaining better service and work at outside points, by a general foreman from an outside point.

The daily inspection of locomotives and tenders as required by Rule 104 I. C. C. Boiler Inspection Laws, by a general foreman.

Valve motion, by a roundhouse foreman.

Locomotive stokers, by a road foreman of engines.

The necessity of properly accounting for labor and material used on locomotives and cars and the advantages derived by the foreman in charge, by a general foreman.

Cause and prevention of hot boxes, by a freight foreman.

The preparation of these papers required considerable thought and effort but it is felt the results fully justified the work, as many of the suggestions were put into effect and proved beneficial.

Besides the papers read at the meetings, discussions often arise; for instance, the use of the locomotive crane as a switcher came up at a Decatur meeting and the direct result was that an order was issued by the superintendent of motive power that a locomotive crane must not move more than a certain number of cars at any time, and the cranes were so marked.

At one of the meetings the question came up relative to sending foremen to other shops and other railroads to see what they are doing and to endeavor to pick up information that would be helpful. This practice was put into effect and foremen now go to other shops occasionally; when they return they are asked to tell what they saw and what practices or methods they think could be used to good advantage in their shops.

The subject of an apprenticeship system has been discussed a number of times at the meetings and men have been sent to other railroads having apprenticeship systems to note what they are doing and to make suggestions for a training system. An apprenticeship committee was appointed by the club to look into this matter thoroughly and after considerable investigating it submitted a final report outlining several plans which was submitted for consideration.

Three or four times a year, the regular monthly business meeting is suspended and a social gathering takes its place. These socials usually consist of a dance, card party, and luncheon to which the families and friends of the supervisors are invited. Also, after the regular business meetings it is customary to have lunch or cigars.

The dues of the club are nominal but sufficient to pay for the rental of the hall and the social functions and sometimes even to assist the shop employees association with social functions. etc.

Sometimes, in lieu of papers, motion pictures are shown. These motion pictures are generally operated by representatives of supply companies, who also lecture on the subject. Pictures on the locomotive booster, operation of a certain milling machine, the manufacture of wrought iron pipe, welding, and the method of making acetylene gas and oxygen were shown at Decatur. These were all interesting and brought before the members, in a very vivid manner, things that were new to them.

Attendance at the meetings is not compulsory but an effort is made to have as many members present as possible.

Conclusions

It is difficult to determine just how much good this organization does, but it is safe to say that the exchange of ideas and the suggestions and constructive criticism cannot help but result in the adoption of better methods and the elimination of wasteful and unnecessarily expensive practices. In addition, it brings the supervisors from the various departments together on an equal footing to discuss subjects of interest and "iron out" and settle various controversies or disputes.

† The superintendent of motive power thought so well of the paper on engine failures that copies were made and distributed to various places along the line.

Steel treaters prepare for September convention

Technical program covers wide range of subjects—S. A. E. and A. S. M. E. to participate

PREPARATIONS are about completed for the eighth annual convention and steel exposition of the American Society for Steel Treating to be held in Chicago during the week of September 20. The technical sessions will be held in the ballroom of the Drake Hotel, the headquarters, on the morning and afternoon of each day from September 20 to 24, inclusive.

The exposition will be held on the Chicago Municipal Pier which contains 80,000 sq. ft. of space. Practically 75 per cent of the equipment at the exposition will be shown in operation. The exposition will be open each day from 10 a.m. until 10 p.m. with the exception of Thursday, September 23, when it will close at 6 p.m. because of the annual banquet scheduled for the ballroom of the Drake Hotel that evening.

Metallurgical education

A feature of the convention is a conference on metallurgical education, which is scheduled as a luncheon meeting at the Drake Hotel, 12:15 p.m., Tuesday, September 21. The program will be divided into two parts: The metallurgical educational work by educational institutions and the metallurgical educational work by the chapters of the A.S.S.T. The discussion of the first part will be led by Professor Bradley Stoughton, Lehigh University, Bethlehem, Pa., and the introduction to the second part will be presented by President R. M. Bird of the society.

Session on steel melting

The plan, so successfully started at the Cleveland convention last year, of holding a technical session devoted to the subject of steel melting will be continued this year. The program is under the direction of W. J. Priestley, Electro Metallurgical Sales Corporation, New York. Three papers have already been promised for this session and one or two more are expected.

The Society of Automotive Engineers has arranged to hold its annual production meeting the same week as the convention of the steel treaters. The tentative program calls for technical sessions on September 21, 22 and 23 at the Sherman Hotel, which will be the headquarters. Members will be invited to participate in all the activities of the steel treaters during the week.

The council of the American Society of Mechanical Engineers has authorized the society to participate in the annual A.S.S.T. convention in the form of a day's session on machine shop practice.

Railroad representative appointed

At the meeting of the board of directors of the society during the recent sectional meeting held at Hartford, Conn., it was decided, in pursuance of a suggestion that the railroads be represented on the recommended practice committee of the society. The appointment of J. H. Gibboney, Norfolk & Western, as representing the railroads, was approved by the board and Mr. Gibboney's acceptance was announced.

Many industrial plants will be visited

A fairly comprehensive program has been arranged for plant visitations during the convention. The following general program has bene arranged:

Tuesday, Sept. 21: Trip No. 1. Buda Company and drop forge department of Wyman-Gordon Company, Harvey, Ill.; Trip No. 2. Lewis Institute and Miehle Printing Press & Manufacturing Company; Trip No. 3. American Forge Company and tractor works of the International Harvester Company.

Wednesday, Sept. 22: Trip No. 4. West Pullman works of the International Harvester Company; Trip No. 5. Indiana Harbor plant of the Youngstown Sheet & Tube Company and the plant of the Inland Steel Company; Trip No. 6. Danley Machine Specialties Company, Inc., Chicago; Trip No. 7. Pettibone Mulliken Company, electric furnace production of manganese steel and its heat treatment.

Thursday, Sept. 23: Trip No. 8. Western Electric Company; Trip No. 9. Plant of the Interstate Iron & Steel Company and of the Illinois Steel Company, South Chicago.

Friday, Sept. 24: Trip No. 10. Burnside shops of the Illinois Central and the plant of the Pullman Car Works; Trip No. 11. Columbia Tool Steel Company's and the American Manganese Steel Company's plants at Chicago Heights; Trip No. 12. Die block plant of A. Finkl & Sons and the plant of the Aetna Ball Bearing Company; Trip No. 13. Armour Institute of Technology.

The technical program

While the complete technical program has been decided upon, only a partial list of convention papers has been made public and is as follows:

"Wear resistance of carburized steel versus cast high manganese steel" by W. J. Merten.

"Internal stresses in quenched steel" by S. L. Hoyt.

"Graphitization at constant temperature below the critical point" by H. A. Schwartz and H. H. Johnson.

"The iron-molybdenum system" by W. P. Sykes.

"The nature of oil-hardening non-deforming tool steels" by E. C. Bain and M. A. Grossmann.

"The decomposition of the austenite structure in steels" by R. L. Dowdell and O. E. Harder.

"Some notes on fatigue properties of heat-treated carbon steels" by J. M. Lessells.

"Cyanide brittleness" by V. E. Hillman and E. D. Clark.

"Wear testing of gage steels" by H. J. French.

"Notes on the A_3 stable transformation" by H. A. Schwartz.

"Dendritic crystallization and grain formation in steels" by V. N. Krivobok.

"Corrosion—Fatigue of steel" by D. J. McAdam, Jr.

"Studies on electric welding" by L. J. Weber.

"Mechanical and machining properties of annealed cast iron" by G. C. Priester.

"Use of electricity in heat treatment furnaces" by A. E. White.

"Failures in bolt steels" by V. T. Malcolm.

"On the transformation of retained austenite into martensite by stress" by Kotaro Honda and Keizo Iwase.

"Krupp nitrifying process" by T. H. Nelson.

"Effect of heat treatment on the properties of stainless iron at various temperatures" by P. G. McVetty.

"Aluminum bronze" by Jerome Strauss.

"Standardizing the Brinell hardness test" by H. M. German.

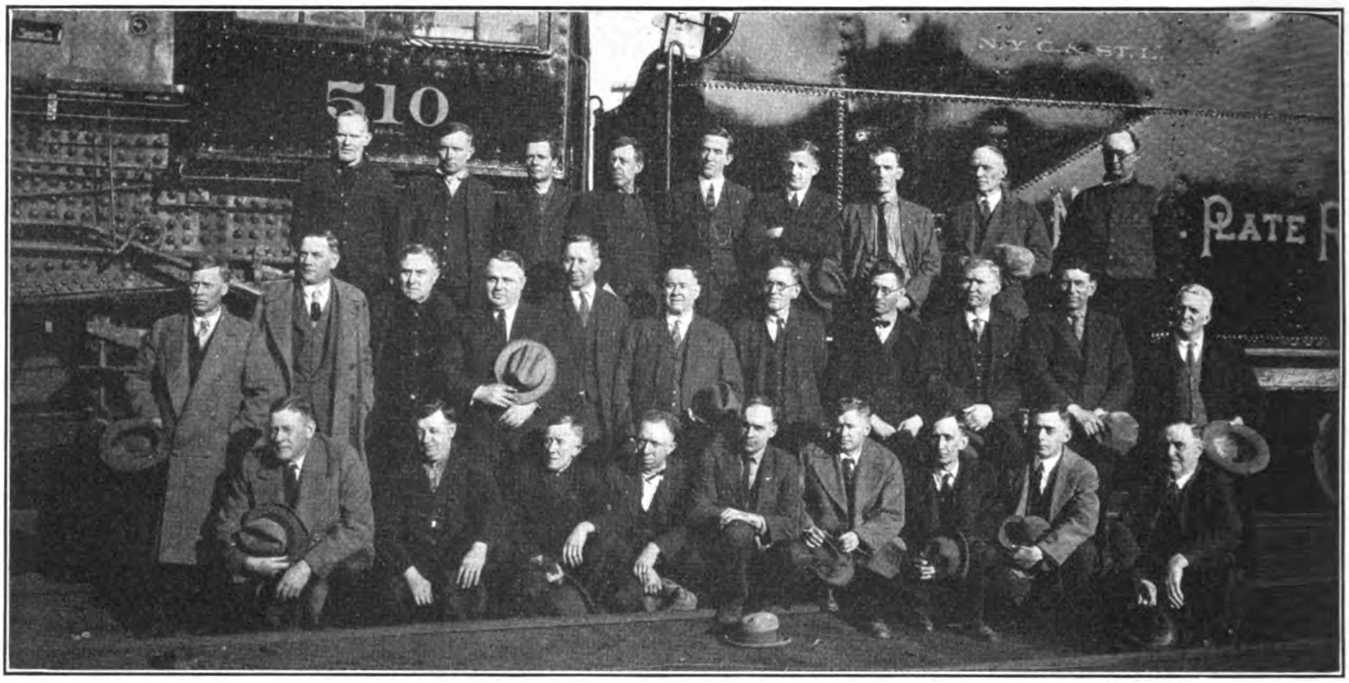
"Correlation of magnetic properties with mechanical hardness in cold-worked metals" by S. R. Williams.

"Hardness testing outfit for steel balls" by S. R. Williams.

"Basic open-hearth practice" by C. H. Herty, Jr.

"Temperature distribution and heat flow in steel during its solidification" by A. L. Field.

"Hair cracks in steel rails" by J. H. Whiteley.



Foremen's club at the Lima, Ohio, shops of the New York, Chicago & St. Louis.

Training for leadership

Several additional suggestions to the survey published in our June number

A COMPREHENSIVE survey of what is being done by the mechanical departments of the railroads in helping to improve the standards of supervision was published in the June number of the *Railway Mechanical Engineer,* page 330. Since the publication of that article a large number of comments and suggestions have been received from railroad officers and others who are interested in this question. Incidentally, a number of requests have been received for more specific information about the formation of foremen's clubs. Those who are interested in this phase of the question will be helped by two articles which appear elsewhere in this issue. One of these, by J. M. Ganley, tells how the supervisors' clubs on the Wabash were organized and are conducted, and outlines some of the more important topics which have been discussed, noting some of the beneficial results which followed specific meetings. The other article, by Supervisor of Apprentices C. Y. Thomas, of the Kansas City Southern, is entitled, "Making Foreman Training a Reality." It makes constructive suggestions as to the programs and procedure of such clubs.

The following article is somewhat in the nature of a symposium of other comments and criticisms of the survey:

New type of leadership

"There is one observation anent your article," said a keen observer of railroad organization, "that I would like to make, to wit: the wonderful improvement in the shop foreman. By improvement I mean an all-around, well-balanced growth, resulting in the accomplishment of more work, with less friction and lost motion. The days of the bulldozing and cursing foreman are gone forever. Today most of the foremen in railroad shops are students of modern shop practices, gentlemen considerate of their men and interested in their welfare. In the old days it was always a mystery to me how a foreman expected to get the most out of his men by constantly waving aloft his authority. The fairness of the modern shop foreman is evident to every one who comes in contact with him."

Inspiration from the chief executive

"It is, however, proper to add," said a vice-president of a large system, "that leadership is inspired from the top. In the case of this system, we are fortunate in having in our president a leader whose example has a beneficial effect on all ranks of employees. He continually advances the policy of good service and, by his appreciation of all that is done to this end, stimulates all with the desire to do well. It is impossible to overstate the value of this, and it should not be overlooked when the problem to which you refer is being considered."

Get-together meetings

"The article in your June number is very complete in itself," writes J. W. Cyr, superintendent motive power, Chicago, Burlington & Quincy, "and the only thing I can think of is that our experience on the Burlington indicates that get-together meetings do more for educational training than any other single source of information."

Studying rules and practices

"Another thing we do over the line," writes George F. Hess, superintendent motive power, Wabash Railway, "which we feel is improving the standing of our

foremen, is to have the assistant master mechanic hold a class at each terminal point. These classes are generally held after the day working force is through work, and we have the day and night foremen attend them, as well as locomotive inspectors and men in the shop generally known as federal inspectors. They go over the I. C. C. boiler and locomotive inspection rules. We do this by asking the men to quote a rule and then have a discussion on it, so that there is no misunderstanding. We have also inaugurated at some terminals, and which we think will be extended, the practice of foremen and inspectors writing one rule a day and giving it to the foreman. If they want to, they may copy the rule from the book, but we feel writing will impress it on their minds better than simply reading it. After we are through with the book of rules, we may go to different instructions that have been issued by the company from time to time, so as to get these men thoroughly familiar with all the rules and instructions in effect."

How to form conclusions

"We believe some of the plans recorded," writes L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul, "will in time become top-heavy, due to the fact that foremen oftentimes consider educational programs burdensome, when the subjects are not directly connected with their particular branch of service. For this reason we have during the current year made a complete change in the subjects of papers prepared for our various staff meetings and also inaugurated a new plan of discussion, which seems to have created added interest in our meetings. For your benefit I quote herewith one of our latest methods of finding a satisfactory conclusion in any special problem.

"We should never enter upon a weighty undertaking without complete mastery of the facts. A successful man is one who is perfectly capable of reaching important conclusions quickly and brilliantly, but such decisions should always be founded on certain knowledge and experience and reflect the operations of a good memory. Whether it be in the course of our daily routine or in our application toward a satisfactory conclusion of a special problem, let us bear in mind and be guided by the following seven points:

"1. Determine what result is desired.

"2. Determine the fundamental which measures the result that is desired.

"3. Divide the problem into (a) human problems, and (b) material problems.

"4. Determine the fundamental of each which should be used as a standard unit to bring about the desired result.

"5. Determine each and every variable, (a) permanent, (b) temporary.

"6. Locate the value of each variable and its relation to the others in the problem.

"7. If a combination of a human and a material problem is to be dealt with, (a) acquire full knowledge of the problem; (b) with this knowledge (or facts) determined for a desired result, see that such facts are put into the proper terms for usual application; (c) it then becomes the problem of the supervisor to develop the procedure to utilize in full the facts located by the study made."

Constructive suggestions

"I spend a great deal of time in handling men, to impress upon them the value of leadership and personality," writes Hugh Montgomery, superintendent motive power and rolling stock, Rutland Railroad. "Leadership is born, and to train a man to see things and do things at the right time and in the right way is a difficult task.

"We have shop meetings once a week to discuss the problems that come up and plan for the next week's work, and I feel that we have obtained wonderful results from these meetings. We also have other meetings on different subjects on different parts of the line, which are attended by all the foremen, and every effort is made to improve leadership; not only leadership, but also the application of the Golden Rule—to use the men under them as they would like to be used themselves.

"I have found in handling men that they look up to the man who does things in the right way. Men will follow a leader where they will lay down under a driver. Having foremen's meetings also will accomplish a great deal to encourage the men in their efforts and put pride in them.

"I try to make all my foremen feel that the railroad is their railroad—the better work they do the better it will be for themselves and the railroad. It is always a pleasure to me to go out and meet them, because they are more like a family. Every one is trying to accomplish the best possible, and, as you say in your article, this cannot be measured in dollars and cents."

Another foremen's club

"We are forming a club at Derby, which, of course, is the central point of the mechanical department on our line," writes W. G. Knight, mechanical superintendent of the Bangor & Aroostook, "and expect to follow the scheme used on the Boston & Maine. It is difficult to get our outside foremen in, especially during the winter time, but we expect to take care of the situation by sending to all foremen who cannot get to headquarters a copy of the proceedings of each meeting."

Talks from officers

"There is not much that we can add to the article, which is instructive," writes T. A. Foque, general mechanical superintendent, Minneapolis, St. Paul & Sault Ste. Marie. "One thing that we have done and which I think that I have not mentioned is that occasionally we have an officer from some other department speak to our foremen. For example, we have had a talk on taxes and accounting, as well as talks by the general storekeeper and traffic officials. These give the foremen an insight into matters foreign to their work, but which are interesting and instructive.

"Another policy that we have followed is to give special attention to shopmen who are likely to be selected to fill positions as supervisors. We make it clear to such men that, while there may be nothing in sight at present, we desire to have them know that they are considered, so that they can study their jobs from the viewpoint of a supervisor. It is not always the best mechanic who makes the best foreman, and we are sometimes disappointed in our selection because of the inability of our appointees to properly handle men. I think it would be interesting to have you prepare another article pertaining to the selection of men."

Visits to other shops

H. L. Worman, superintendent motive power, St. Louis-San Francisco, writes: "Arrangements are made whereby supervisors are permitted to visit special installations at other railroad shops or where new shops are placed in operation, in order to gain information relative to methods or equipment that is more modern than that in use on this road."

Col. George H. Emerson, chief of motive power and equipment of the Baltimore & Ohio, says as to the selec-

tion of men for supervisory positions and their training: "It is the usual practice to select men who have served their apprenticeship in company shops and have taken the apprenticeship course in mechanical drawing. In the case of applicants for such positions, who have not had this training, we propose to give them the opportunity to acquire same, and we are now working on a plan of special training for apprentices and supervising officers through one of the correspondence schools which has such a course available."

Making foremen from piecework inspectors

A superintendent motive power makes the following suggestion: "I have looked over this article very carefully and have no criticism to make, except in my previous letter I did not particularly mention the fact that the introduction of piecework in the locomotive shops makes it necessary to appoint a number of piecework inspectors, taken from their respective crafts. These men are generally selected with the thought in mind that they may some day be advanced to foremen, and it gives the management an excellent opportunity to observe and get acquainted with them before they are advanced; it also gives the inspector an opportunity to show what ability he may possess toward filling an appointment of that kind."

A difficult educational problem

"As to the technical books and publications referred to," writes C. F. Giles, superintendent machinery, Louisville & Nashville, "I am not so sure that this would accomplish the purpose desired. My experience is that very few shopmen, or boys, can be induced to read technical papers or books. They will attend lectures occasionally and some are willing to participate in club meetings after shop hours, especially at the smaller terminal points. It is not an easy matter to attract them to such meetings at terminals located near large cities. They find many other things to divert their attention. Much of the art of railroading, like other businesses, must be absorbed; it can neither be drilled or hammered in. The absorption process obviously is one which calls for time. We aim to encourage all seekers of information by personal contact, as far as it is practicable to do so."

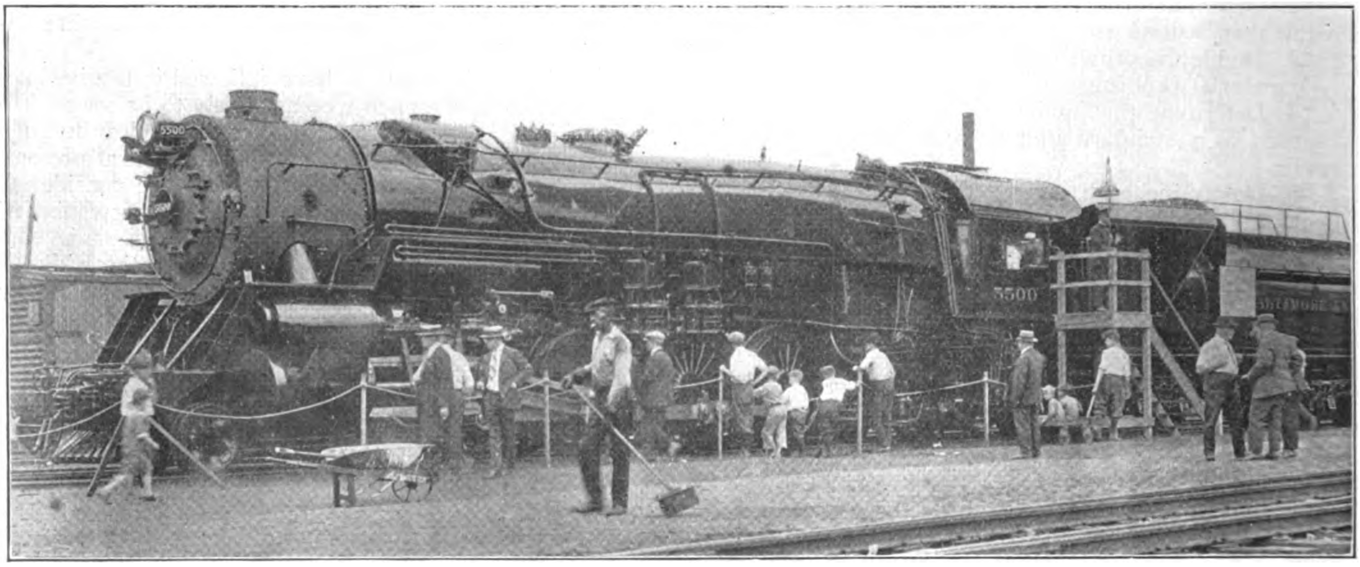
Industrial management course

"There is only one other thing connected with this institution which might have been included in your survey," writes W. R. Young, of the Department of Engineering Extension of the Pennsylvania State College. "In June of each year the industrial engineering faculty of our college co-operates with the Department of Engineering Extension to give an industrial management course. This course is intensive and covers a period of two weeks. It deals with all phases of management from the standpoint of the executive.

"This year the Nickel Plate sent four of its foremen to take up this course. While the industries have been sending men here for years, the railroads never took any interest until this year. These four men who did attend were very outspoken in expressing the benefit derived from the training which they received."

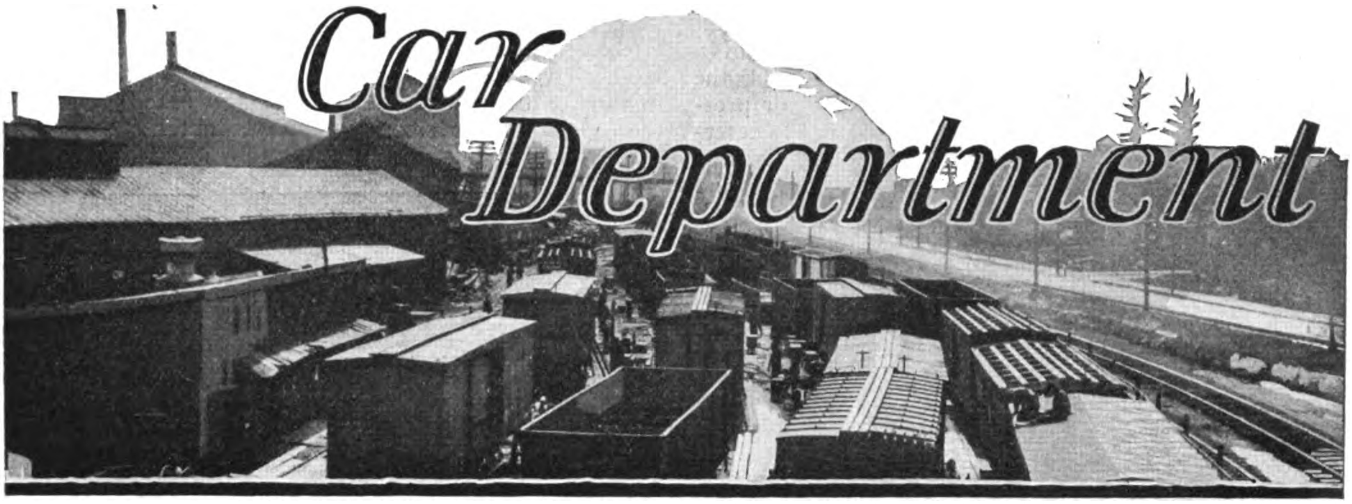
Conclusions

These are a few of the many comments which have been drawn forth by the article in the June number of the *Railway Mechanical Engineer*. One thing which is quite evident from the mass of correspondence which has been received is that many of the mechanical departments are planning on tackling more aggressively this problem of improving supervision and leadership. It is interesting, also, to note as one travels about the country that much really effective work is being done in a perfectly natural way, which is producing splendid results in stimulating the foremen and supervisors to more intelligently develop leadership ability, and yet which is not formally recognized as being specially directed toward this end—at least our attention was not specifically drawn to it when we received reports from some of these railroads. One outstanding piece of work of this sort we hope to have the privilege of drawing attention to in an early issue.



P. & A.

Mountain type locomotive rebuilt from a Santa Fe type by the Baltimore & Ohio, at its Mt. Clare shops, Baltimore, Md., for use in heavy passenger traffic—Total weight of engine, 400,000 lb.; total engine wheel base, 41 ft. 4 in.; diameter of drivers, 74 in.; rated tractive force, 65,000 lb.



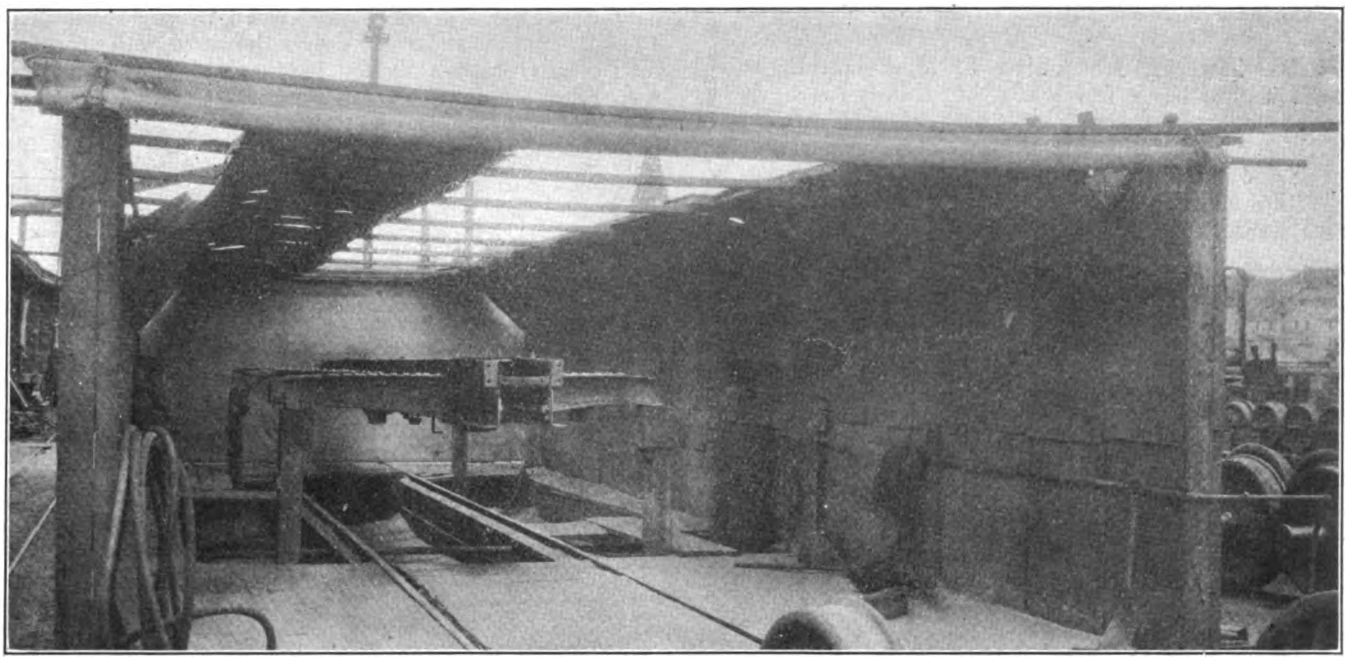
Car shop kinks at Aurora

CAR repair work is handled by the progressive system at the Chicago, Burlington & Quincy shops, Aurora, Ill., a description of this operation having been published beginning on page 284 of the May, 1925, *Railway Mechanical Engineer*. Important factors in the good results secured are the many tools, devices and methods which expedite work at the different stations, thus providing increased production.

Steel needle beams and underframes for new and rebuilt cars are sand blasted before painting, which gives a far better job than could be done by hand cleaning and at considerably less cost in time and labor. These underframes, built of reclaimed parts where possible and new pressed steel shapes, are exposed more or less to the weather after fabrication. As a result it is desirable to clean the entire structure of rust, dirt and scale before painting and this work is done at one of the stations in the regular line up of operations. The finished underframe is moved to a station devoted to sand blasting and immediately thereafter to the next station where a coat of Continental cement is applied with a special spray gun.

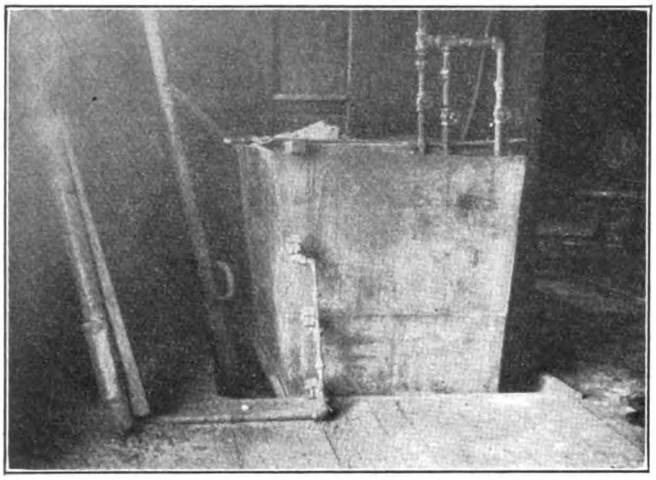
The actual work of sand blasting the underframes takes place in an enclosure built to accommodate a 50-ft. frame. As shown in one of the illustrations, the sides consist of a wooden frame covered with scrap car roofing and extending inward at the top at an angle of 45 deg. to deflect the sand back into the pit. Canvas curtains are provided at the front and back of the enclosure. The top is left open in order to afford good illumination and permit the escape of the fine light dust which would soon make working conditions unbearable in a totally enclosed space.

A simple and effective sanding apparatus has been developed which consists of a tank filled with sand un-



View of the station where underframes are sand blasted

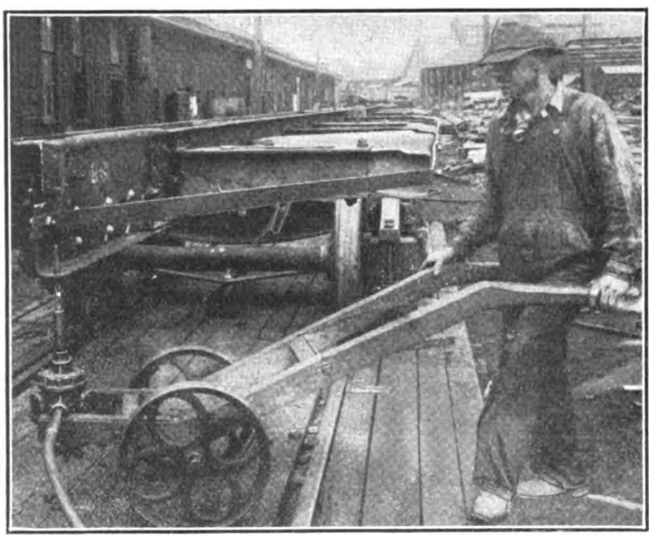
der pressure from the top and a suitable arrangement of piping valves, rubber hose and nozzle made of a section of straight pipe. In starting to sand blast, the air is first permitted to blow through the hose, air pressure then being applied on top of the sand in the reservoir which forces the sand slowly through the bottom into the stream of air which conveys it to the hose and nozzle. In stopping work, the reverse operation is followed, air being shut off from the top of the sand first in order to prevent clogging and stoppage in the piping and connections just ahead of the hose. Experience at Aurora has shown that the heavy 2-in. air hose does not cut or wear with objectionable rapidity. The



Sand drier in house adjacent to the sand blasting shed

nozzles, however, are subject to rapid cutting, sometimes lasting but a few hours, but this is not a serious item of expense as the nozzles consist simply of straight sections of 1-in. pipe, of the proper length, carried in stock and quickly changed.

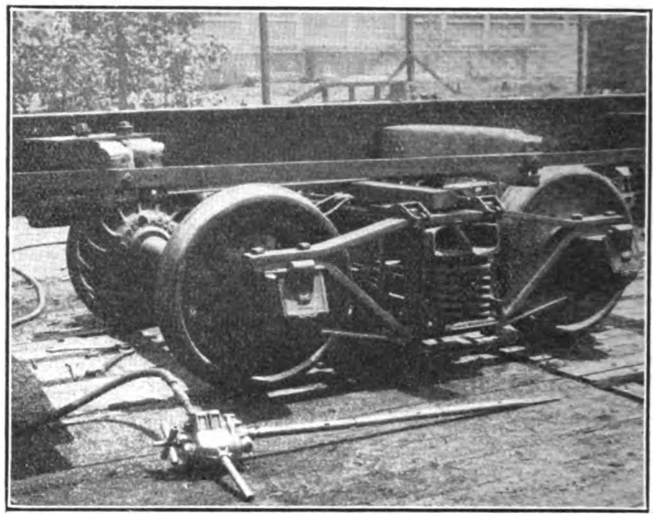
White silica sand is used, being unloaded from cars to a storage bin and dryer by vacuum and again by



A two-wheel truck with permanent air motor attachment for drilling or reaming underneath cars

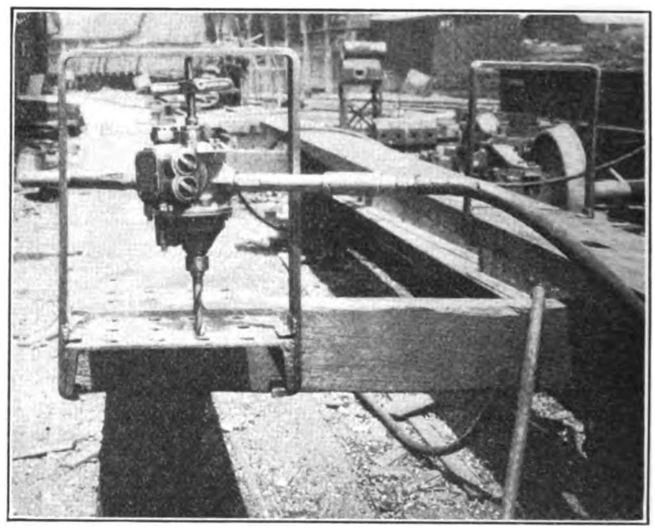
vacuum to the storage reservoir. In case of rain, sand in the pit becomes wet and has to be handled back to the dryer. The durability and good cutting qualities of this sand are indicated by the fact that a single box car of sand proved sufficient for the sanding of more than 400 underframes. The sand is re-used a number of times until eventually it becomes so fine as to prevent effective cutting of the scale and foreign material on the steel. Two operators are generally used for sand blasting and on the underframes now being worked the schedule calls for a movement every 40 minutes.

One of the illustrations shows a device for perform-



This extension reamer greatly facilitates reaming holes in inaccessible parts of the underframe

ing reaming operations on the under side of steel underframes which combines safety and time saving features. Pneumatic motors for either drilling or reaming operations are absolutely safe when properly handled. They develop considerable power, however, and on more than one occasion a sudden binding or stoppage of the

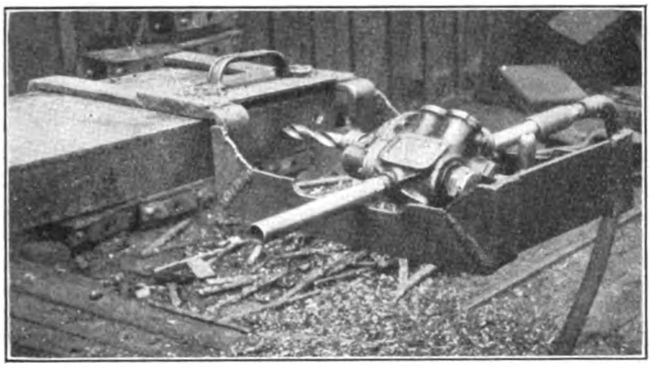


Readily adjustable jig for use in drilling the web of a channel

drill or reamer in the hole causes the air motor handles to be jerked out of the hands of the operator, resulting in his injury. The construction shown in the illustration prevents the possibility of accidents of this kind.

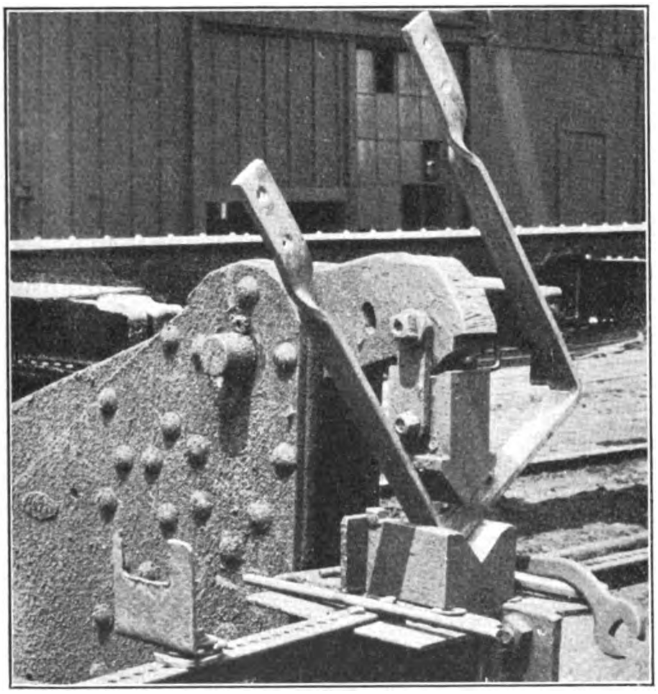
The air motor is supported on the front end of a rebuilt two-wheel truck, being held in place by two J-hooks or U-bolts around the handles which permit the motor to revolve in a plane at right angles to the truck axle. The method of operation is simply to push the truck under the car frame, enter the drill or reamer at the proper point and turn on the air to start the motor. Downward pressure on the truck handles then feeds the motor and reamer upward the required amount to ream

the hole. One man is required at the handles of the truck and another at the motor because experience has shown that this arrangement facilitates more rapid entering of the reamer in the hole, which cannot be readily seen by the man at the truck handles. This device is said to save two-thirds of the labor formerly involved in underneath reaming operations on steel needle beams and underframes.



This view shows a device which facilitates drilling channel flanges

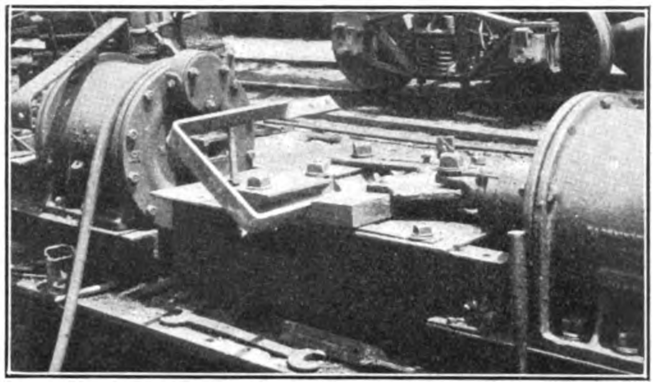
Considerable thought has been given to the question of drilling operations and the location of equipment for handling this work where it can be done to the best advantage. Where a large number of holes are required in a long new channel, I-beam, or other structural shape, these holes are punched on a power space punching machine, but if a few holes only are required, such as the draft rigging holes in channel ends, these holes are drilled at one of the regular stations with pneumatic motors which saves handling the long, heavy channels to a punching machine and back again. This method saves time and labor.



Pneumatic machine arranged for making 90-deg. cold bends in car sill steps

Two ingenious devices for supporting the air motors when drilling horizontally and vertically are shown in the illustrations. The jig for vertical drilling consists simply of a strap of ½-in. by 3-in. iron bent as shown and provided with shoulders or jaws welded on the lower ends at the proper point so as to fit around the channel. There is sufficient spring in the iron to permit slipping it on over the channel and no adjustment of bolts, nuts, or blocks is necessary. When a hole is required at some other point on the channel it is only a moment's work to move the jig and set up the motor. The jig for horizontal drilling, while differing somewhat in detail, is adjusted with equal ease and rapidity. This construction is shown in the lower illustration in the second column, page 544.

Considerable cold bending work is being done at the Aurora car shops with desirable results in time saving, and two operations required in forming car sill steps are shown in the illustrations. Door brackets, fasteners, stock car fittings and other parts not subject to severe strain can be formed by this method with marked economy, the saving being due to reduced labor cost as well as a saving of time and fuel required for heating operations in a furnace. In forming the sill step illustrated, the first operation consists of making a 90-deg. twist at two points in a straight piece of bar stock of the required cross section. Ninety-degree bends are then made at the proper points in the second machine, the entire operation being performed in a fraction of the time required for heating and hot bending. By the use of suitable dies and machines shown in the accompanying illustrations can be arranged for the cold bending of many other car parts.



The 90-deg. twist in sill steps is made cold in this machine

View showing a number of completed car sill steps

Condensed table of A. R. A. rule No. 101 for the car repair accounting bureau

Table A—Couplers and parts

	1	2	3	4	5	6	7
	Gross price		Credits				
	new	s.h.	Scrap body o.p. o.k.	Scrap body and kn'le o.p. o.k.	Scrap body kn. and l. o.p. o.k.	All parts scrap	Scrap body only
5 in. by 7 in. (D)..	24.45	18.34	8.14	4.36	3.09	2.01	1.35
6 in. by 8 in. (D)..	24.75	18.56	8.22	4.44	3.17	2.09	1.43
5 in. by 5 in. ord....	18.85	14.14	7.02	3.84	1.81	1.40	.98
5 in. by 5 in. temp..	20.20	15.15	7.19	4.01	1.98	1.57	1.15
5 in. by 7 in. ord.*..	9.41	9.41	....	....	....	....	1.10
5 in. by 7 in. temp.*	10.35	10.35	....	....	....	....	1.23

*The price shown for 5 in. by 7 in. ordinary and 5 in. by 7 in. temporary standard covers the body only. All parts used in connection with same should be billed in addition at prices shown below.

	1	2	3	4	5
	Gross price			Net price	
	new	s.h.	Credit	new	s.h.
Type (D) Parts:					
Knuckle	5.70	4.28	.50	5.20	3.78
Knuckle lock	1.80	1.35	.08	1.72	1.27
Knuckle pin	.60	.45	.04	.56	.41
Knuckle lock lifter	.35	.26	.01	.34	.25
Knuckle lock thrower	.60	.45	.03	.57	.42
Ordinary Parts:					
Knuckle	4.65	3.49	.31	4.34	3.18
Knuckle lock	2.80	2.10	.07	2.73	2.03
Knuckle pin	.60	.45	.04	.56	.41

Table C—Brake beams and parts

	1	2	3	4	5
	Gross price			Net price	
	new	s.h.	Credit	new	s.h.
No. 1	2.40	2.40	.40	2.00	2.00
No. 2	5.95	4.45	1.80	4.15	2.65
No. 2 plus	6.35	4.75	1.90	4.45	2.85
No. 3	7.35	5.50	2.20	5.15	3.30
Non A.R.A.	2.02	2.02	.35	1.67	1.67
P. S. Bk. rod	2.40	2.40	.12	2.28	2.28
Brake shoes, each	....	....	....	.63	No B.
Brake shoe keys, each	....	....	....	.08	.08

Table H

Side door, box or stock car	11.20
Side door, reinforced	18.75
Side door, box, ventilated	13.20
Side door, auto, single over 6 ft.	12.00
Side door, stock with iron rods	12.80
Side door, stock, one half	5.63
Side door, auto, twin or half	12.00
Half door or twin door, auto, reinfor'd	19.00
Half door or twin door, right hand with fixtures for side of refrigerator car	24.45
Half door or twin door, left hand for side of refrigerator car	17.35
End door, box or stock cars	3.20
End door, vent. wood with iron rods	4.00
End door, half for auto or carriage	12.34
Roof of coke car	2.40
Roof of stock car	2.40
Hatch cover	3.50
Hatch plug	4.00

Table B—Wheels

	1	2	3	4	5	6
	Gross price			Net price		
	new	s.h.	Credit	new vs. s.h.	new vs. sc.	s.h. vs. s.c.
Cast iron 7 in. and 8 in.	15.05	8.30	5.25	6.75	9.80	3.05
Cast iron 9 in.	16.25	8.95	5.80	7.30	10.45	3.15
Cast iron 10 in.	17.40	9.55	6.30	7.85	11.10	3.25
Cast iron 11 in.	19.70	10.85	7.30	8.85	12.40	3.55
Cast steel	36.00	18.00	2.00	18.00	34.00	16.00
Wrot steel (one wear)*	21.28	15.19	3.00	6.09	18.28	12.19
Wrot steel	.....	.....	3.00	.....	.....	.....

Service metal—per each 1/16 in. 1.07.†
Labor turning steel wheels 1.4 hours.

Note: This table is figured on the price of one wheel only.

*No turning allowed on one wear wrot steel wheels. Scrap when defective.

Axles

Capacity	C	D	E	F	H		1 Gross price new	2 Gross price s.h.	3 Credit	4 Net price new vs. s.h.	5 new vs. s.c.	6 s.h. vs. s.c.
1 in. 40,000 lb.	3¾ in.	5⅛ in.	4¼ in.	7 in.	⅝ in.	New	17.72	10.63	2.80	7.09	14.92	7.83
	3¼ in.	4⅞ in.	4 1/16 in.	7½ in.	¼ in.	Limit						
8 in. 60,000 lb.	4¼ in.	5¾ in.	4¾ in.	8 in.	⅝ in.	New	21.10	12.66	3.41	8.44	17.69	9.25
	3¾ in.	5½ in.	4 11/16 in.	8½ in.	¼ in.	Limit						
9 in. 80,000 lb.	5 in.	6½ in.	5⅜ in.	9 in.	¾ in.	New	27.80	16.68	4.59	11.12	23.21	12.09
	4½ in.	6¼ in.	5¼ in.	9½ in.	¼ in.	Limit						
10 in. 100,000 lb.	5½ in.	7 in.	5⅞ in.	10 in.	¾ in.	New	33:35	20.01	5.56	13.34	27.79	14.45
	5 in.	6¾ in.	5¾ in.	10½ in.	¼ in.	Limit						
11 in. 140,000 lb.	6 in.	7⅝ in.	6 7/16 in.	11 in.	⅞ in.	New	40.55	24.33	6.44	16.22	34.11	17.89
	5½ in.	7⅜ in.	6 5/16 in.	11½ in.	¼ in.	Limit						
12 in. 200,000 lb.	6½ in.	8⅛ in.	6⅞ in.	12 in.	⅞ in.	New						
	6 in.	7⅞ in.	6¾ in.	12½ in.	¼ in.	Limit						

Symbols: C—Diameter of journal. D—Diameter of wheel seat. E—Diameter of center. F—Length of journal. H—Thickness of collar.

Table D—Journal bearings

	7 in.	8 in.	9 in.	10 in.	11 in. or over
Gross price	1.60	2.08	3.20	4.00	5.92
Credit	.66	.88	1.32	1.65	2.53
Net price	.94	1.20	1.88	2.35	3.39

Table E—Dust guards

8 in.	.15
9 in.	.17
10 in.	.20
11 in.	.22

Table F—Journal wedges

7 in.	7 lb.
8 in.	9 lb.
9 in.	15 lb.
10 in.	19 lb.
11 in.	25 lb.

Table G

Rivets, first any size each	.48
Rivets, all others ¼ in. each	.07
Rivets, all others ⅜ in. each	.12
Rivets, all others ½ in. each	.12
Rivets, all others ⅝ in. each	.25

Table I—Miscellaneous items

	Gross	Credit	Net
Galvanized iron	....	....	.06
Wrot, per pound	.005	.005	.05
Cast, per pound	.04	.005	.035
Mall, per pound	.105	.005	.10
P. s., per pound	.045	.005	.04
P. s. (fabricated)	.05	.005	.045
P. s. (mall. integ.)	.06	.005	.055
Cast steel (100 lb. or less)	.105	.005	.10
Cast steel (over 100 lb.)	.08	.005	.075
Springs	.045	.005	.04
Chain	.08	.005	.075
Chain bk. beam safety	.08	.005	.075
Lumber	....	....	.08
Steel, tank head, (flanged, dished and bev.)	.075	.005	.07
Steel, structural	.04	.005	.035
Labor, per hour	....	....	1.00
Straightening parts off car (per 100 lb.)	....	....	1.70

Box lids, P. S., plain	.20
Box lids, P. S., Int. eye	.43
Box lids, malleable	.90
Card boards, each	.35
Wood screws (per 100)	.36
Turnbuckles, each	.75
Staples, each	.01
Clevises	.22
Clevis links	.15
Clevis bolts	.08
Paint, mineral, per lb.	.10
Paint, lead, per lb.	.17
Nails, per lb.	.035
Lag screws, each	.02
Grip nuts, 1 in. or less	.01
Grip nuts over 1 in.	.03
Unit nuts 1 in. or less	.01
Unit nuts over 1 in.	.03
Cotters, separately	.05
Cotters with other repairs	.01

Table J—Draft gears (See note below)

Name	Type	New	S. H.	
Bradford, rocker	24⅝ in. Pocket	51.75	38.81	Cheek castings 11.50 extra per end.
Bradford, imp. spring	24⅝ in. Pocket	54.65	40.99	Cheek castings 8.63 extra per end.
Bradford, 0S3 spring	24⅝ in. Pocket	48.90	36.68	Including cheek castings.
Bradford, 0S4 spring	24⅝ in. Pocket	46.00	34.30	Exclusive of springs and rods.
Cardwell	15½ in. Pocket	28.20	21.15	Exclusive of springs and rods.
Cardwell	18½ in. Pocket	30.75	23.06	Exclusive of springs and rods.
Cardwell	24⅝ in. Pocket	33.25	25.01	
Gould	FDG-110	33.35	25.01	
Gould	FDG-175	33.95	25.46	
Gould	FDG-200	33.35	25.01	
Could	FDG-350	36.25	27.19	
Hall	H-2	46.00	34.50	
Hall	E-14	41.40	31.05	
Hall	K-8	34.50	25.88	
Hall	K-10	35.65	26.74	
Hall	K-10-A	37.95	26.46	
Hall	K-12-E	39.10	29.33	
Hall	K-18	28.75	21.56	
Miner	A-1	34.20	25.65	
Miner	A-2-S	32.20	24.15	
Miner	A-24-S	37.95	28.46	
Miner	A-18-S	45.45	34.09	
Miner	A-18-S-2	48.30	36.23	
Miner	A-69	37.40	28.05	
Miner	A-2-X	32.80	24.60	
Miner	A-18-X-2	48.90	36.68	
Murray	H Class 25	40.35	30.26	
Murray	H Class 25	38.40	28.80	
Stanforge	24⅝ in. Pocket	40.25	30 19	
Symons	Double vee	46.00	34.50	

Gears—Continued

Name	Type	New	S.H.
National,	M-4-A	35.95	26.96
National,	M-11	25.90	19.43
National,	M-17	34.50	25.88
National,	M-18	34.50	25.88
Sessions,	K	34.50	25.88
Sessions,	K-4	34.50	25.88
Sessions,	Jumbo No. 2	54.65	40.99
Sessions,	L	37.40	28.05
Sessions,	C	28.75	21.56
Sessions,	H	34.50	25.88
Walker,	K20A or BP-17	23.00	17.25
Walker,	W-1-BP-503	31.65	23.74
Walker,	W-3-BP-504	31.65	23.74
Waugh,	18⅝ in. Pocket	42.85	32.14
Waugh,	24⅝ in. Pocket	47.00	35.25
Waugh,	23⅞ in. Pocket	46.00	34.50
Westinghouse,	NY-10	32.80	24.60
Westinghouse,	D-4	32.80	24.60
Westinghouse,	N-10-F	46.00	34.50
Westinghouse,	N-11	48.90	36.68
Westinghouse,	N-11-A	48.90	36.68

Draft gears (note)

The prices shown for gears are to be charged for various draft gears applied new complete, when necessary to apply on account of any or all parts of the old gear being defective. In conformity with rule 88, one type of gear may be substituted for another if the type substituted conforms to the one removed as to sill spacing and coupler pocket limits and a defect card should be issued for the labor of correcting wrong repairs when such substitution is made. In such substitution complete gears removed shall be credited at 25 per cent of price new, complete, when removed on account of defective friction casing or defective casing and one or more parts other than the casing; and at 50 per cent of the price new, complete, when removed on account of any part other than casing being defective.

Second-hand complete friction draft gears shall be charged at 75 per cent of price new, complete.

When new or second-hand parts of any type of friction draft gear are applied in replacement of such parts being defective, same should be charged at factory prices, as new, plus 15 per cent.

Short method tables for pricing car repair bills

By John J. Whelan

Assistant chief, car repair accounting bureau, B. & O. Baltimore, Md.

THE car repair accounting department of a railroad receives and sends out many thousands of repair bills. Each bill must be carefully checked as to material and labor charges. Of course, this information is contained in the A. R. A. Code of Rules governing the interchange of traffic. Although the billing clerks memorize many of the most commonly used charges, nevertheless there are many which must be looked up in the book.

Rules 101 and 111 are the two most frequently referred to. In an effort to expedite this work, two tables have been compiled which show, at a glance, the material and labor charges covered in these rules. These tables have been placed under the desk glass with the result that the billing clerks refer to them to obtain the net charge, thus eliminating the necessity of referring to the rule book. Furthermore, the accuracy of the bills has been improved by having the compiled figures before each clerk, thus eliminating the necessity of working out net charges in detail each time a specific charge appears for calculation.

The tables are marked A, B, C, etc. Table A covers couplers and parts and the charges and credits based on the type of coupler applied and removed. Columns 1 and 2 represent the gross new and second-hand prices for the different types of couplers from which the amounts in either Columns 3, 4, 5, 6 or 7 are deducted according to the condition of the coupler removed. The result is the correct net charge.

Example:—A new 5-in. by 7-in. Type D coupler is applied. Referring to Column 1, the charge is $24.45. A 5-in. by 7-in. Type D coupler is removed and all parts are scrapped. Column 6 shows a deduction of $2.01 for the parts which leaves a net charge of $22.44. Columns 4 and 5 of coupler parts show the net price after allowing scrap credit.

Table B refers to wheels and axles and the charges and credits based on the size and condition of the wheels applied and removed. Columns 1 and 2 show the new and second-hand prices of each wheel, while Columns 4, 5 and 6 show the net charge for each wheel, according to the condition when removed.

Example:—Two new 8-in. cast steel wheels are applied and one second-hand and one scrap wheel removed. The net charge is $16.55, which is the combined total of Columns 4 and 5. Columns 4, 5 and 6 under axles, show the net charge to be made according to the size and condition of the axles applied and removed.

Table C refers to brake beams and the charges and credits based on the size of the beam applied and removed. Columns 1 and 2 represent the gross price of new and second-hand beams, while Columns 4 and 5 represent the net charge where the same size beam is removed and applied. Where a different size beam is

Short method table for air brake prices given in A. R. A. rule No. 111

Allow credit at $0.005 per pound for the following parts:

Triple .... 19 lb.
Reservoir ...... 98 lb.
Cylinder .... 60 lb.

All other items, no credit due.

	1 Cylinder and triple C. O. T. & S.	2 Cylinder, (detachable)	3 Cylinder (combined)	4 Cylinder and reservoir, R. & R.	5 Reservoir, R. & R.	6 Cylinder release spring	7 Cylinder gasket	8 Triple valve gasket	9 Cylinder pressure head	10 Cylinder non-pressure head
8 in. material	...	Body 6.72	5.47	....	Det. 9.32	.85	.04	.08	1.27	1.35
	...	Comp. 12.32	11.07	....	Comp 9.32					
10 in. material	...	Body 7.84	6.60	....	Det. 10.74	.85	.05	.08	1.27	2.12
	...	Comp. 16.80	15.55	....	Comp. 11.00					
Push rod	.10	.10	.10	.10	....	.10	.10	...	...	...
Clamping piston	.06	.06	.06	....	....	.06	.06	...	...	...
Cylinder head R. & R.	.12	.12	.12	.12	....	.12	...	...	...	...
Disc. reservoir block	...	....	....	....	....	...	.12	...	...	...
Disc. cylinder	...	....	.21	....	....	...	...	...	...	...
Reclamping	...	.06	.06	....	....	.06	...	...	...	...
Removing cylinder	...	.36	.36	.36	....	...	...	...	...	...
Removing reservoir	...	....	....	.12	.12	...	...	...	...	...
Removing release rods	...	....	....	.12	.12	...	.12	...	...	...
Removing release valve	...	....	....	.06	.06	...	...	...	...	...
Removing two plugs	...	....	....	.06	.06	...	...	...	...	...
Removing triple	.12	....	....	.12	.12	...	...	.12	...	...
Disc. triple union	.10	.10	....	.10	.10	...	.10	.10	...	...
Disc. retainer union	.10	.10	....	.10	.10	...	.10	.10	...	...
Cylinder C. O. T. & S.	1.30	....	....	....	....	...	...	...	...	...
Disc. cylinder and res	...	....	....	....	.21	...	.21	...	...	...
Removing pack. leather	...	....	....	....	....	...	...	...	...	...
Removing check valve case	.06	....	....	....	....	...	...	...	...	...
Emerg. valve seats	.15	....	....	....	....	...	...	...	...	...
Cylinder cap	.09	....	....	....	....	...	...	...	...	...
Triple C. O. T. & S.	1.94	....	....	....	....	...	...	...	...	...
Total	4.14	.90	.91	1.26	.89	.34	.81	.32	.50	...

Pipe per foot	Gross	Credit	Net
3/8 in.	.05	.0025	.0475
1 in.	.10	.005	.095
1¼ in.	.13	.01	.12

	Net
Triple valve body, comp. o. s.	9.10 (W.A.B.)
Triple valve body, comp. o. s.	8.00 (N.Y.)
Triple valve K-1 or K-2 (body)	12.60
Triple valve convertible, comp.	23.13
Triple valve K-1 or K-2 comp.	31.40
Triple valve conversion price	11.30
Air hose gasket	.05
Union gasket (any size)	.05
Triple union nut	.17
Triple union swivel	.17
Release rod	.08

	8 in.	10 in.
Reservoir stud and nut	.09	.09
Pipe strainer	.95	.95
Pipe strainer, union nut	.19	.19
Pipe strainer, union swivel	.19	.19
Dirt collector, 1 in.	1.88	1.88
Dirt collector, 1¼ in.	2.36	2.36
Dirt collector, deflector and plug	.47	.47
Cylinder piston rod	2.12	2.54
Cylinder piston follower	.15	.45
Cylinder piston packing leather	.45	.65
Cylinder piston packing leather, WABCO or JM	.73	.95
Cylinder piston packing leather expander	.08	.10
Cylinder piston packing leather expander, JM. type	.50	.60
Cylinder pressure head with lever bkt. lug	2.20	2.63
Cylinder pressure head detach bkt. only	.28	.28
Cylinder pressure head bkt. and two nuts	.17	.17
Cylinder gaskets	.04	.05

Retainers	Gross	Credit	Net
2 Pos. sing. weight	.70	.42	.28
3 Pos. doub. weight	2.57	2.25	.32
2 Pos. sing. spring	.98	.83	.15
3 Pos. doub. spring	4.67	3.18	1.49
Release valve	1.20	.65	.55
Cut out cock 8 in. or 10 in.	2.22	1.35	.87
Air hose	2.40	.65	1.75
Angle cock, plain	2.35	1.30	1.05
Angle cock, self lock	2.85	1.50	1.35

PIPE

	3/8 in.	1 in.	1¼ in.
Bushings	.02	.03	.04
Couplings	.04	.08	.13
Elbows	.04	.11	.13
Nipples 12 in. or less	.05	.08	.13
Reducing ells	.05	.13	.20
Unions, lip type	.09	.14	.20
Unions, ground joint	.13	.26	.40
Union tee	.19	.27	.36
Threads cut, each	.15	.15	.15
Connections, each	.10	.10	.10

applied and removed, the charge in Column 3 is deducted, to obtain the net charge.

Example—A new No. 2 plus truss beam is applied on account of the removal of a defective No. 1 beam. From $6.35 shown in Column 1, deduct $.40 shown in Column 3, which gives a net charge of $5.95.

Tables, D, E, F, G, H, I and J do not need any explanation as they are a reproduction of the rules to avoid the necessity of referring to the book.

The air brake table is of importance as it covers the overlapping labor features in connection with the other parts applied when a cylinder and triple valve are cleaned, oiled, tested and stencilled. For instance, Column 1 shows in detail the labor charge for cleaning, oiling, testing and stencilling a cylinder and triple valve, while Column 5 shows the detailed labor for removing the reservoir. There are three items of labor overlap in both columns which reduce the reservoir price to $.57, plus $4.14 in Column 1, or a net charge for both items of $4.71. This table saves considerable time in referring to the rules as it would be necessary to locate the three items in the above example.

COPPER STEEL.—A 16-page booklet summarizing the scientific conclusions of various authorities on the value of alloying steel with copper to resist corrosion, has been issued by the American Sheet & Tin Plate Company, Frick building, Pittsburgh, Pa.

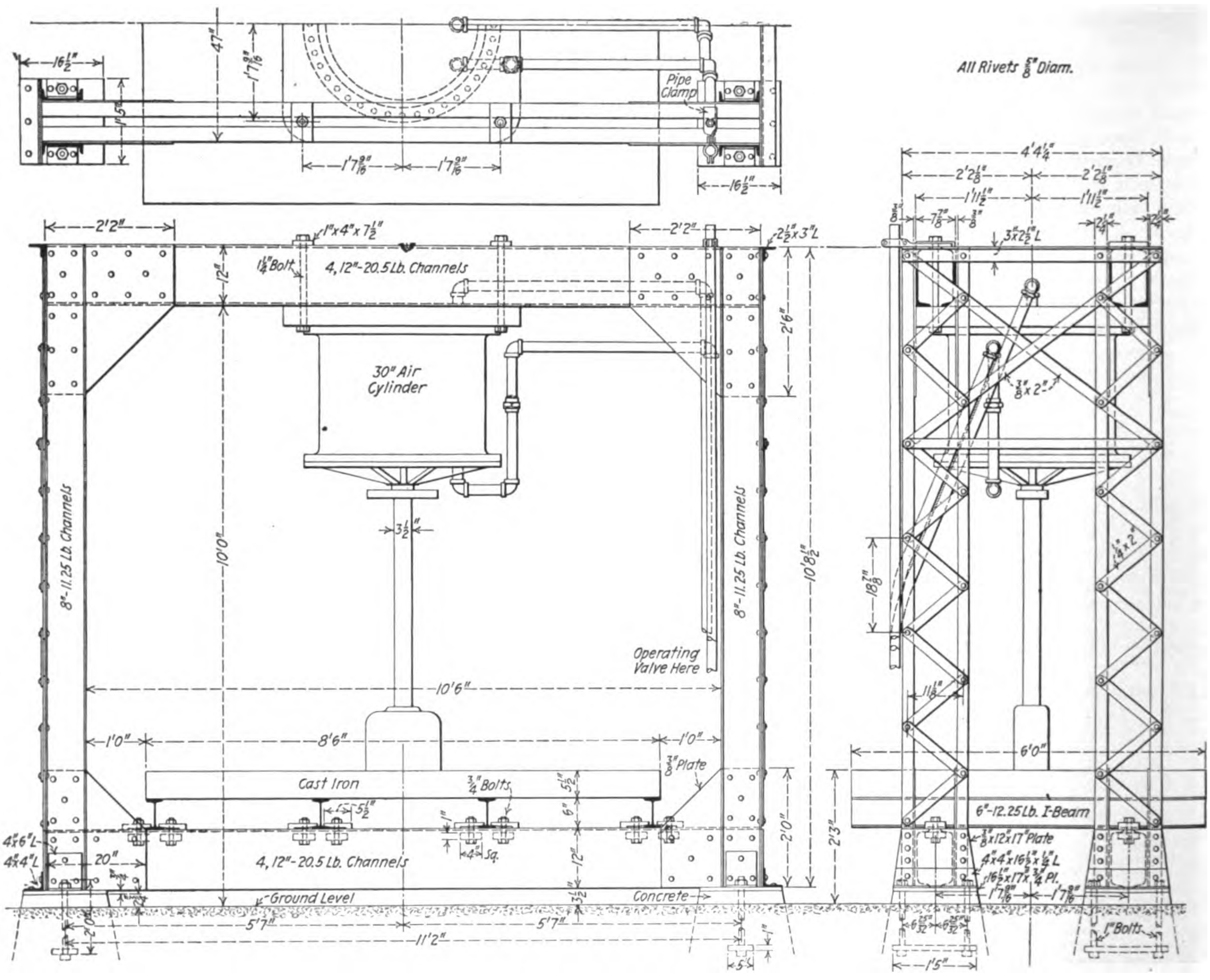
Press for straightening sheets for steel cars

By E. A. Miller

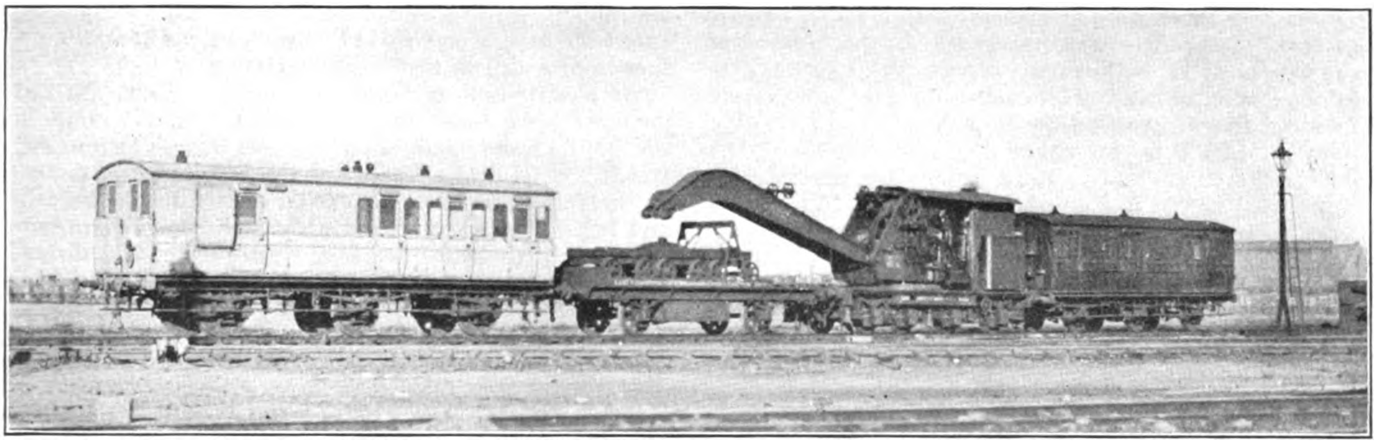
SHOWN in the drawing is an air-operated press which was specially designed for straightening bent plates removed from steel cars going through the repair shop. This press is a standard design on one railroad and can be used for straightening car channels, angle bars or rods if desired. It is of substantial construction throughout and is suitable for heavy work.

The press rests on four concrete piers. On the top of each pier is a ¾-in. plate, 16½ in. by 17 in., on which rests two 12-in., 20.5-lb. cross channels, as shown in the drawing. A 30-in. air cylinder is supported by a frame made of eight 8-in., 11.25-lb. channels composing the vertical members, and four 12-in., 20.5-lb. channels from which the air cylinder is supported. The two 11.5-lb. channels are placed back to back and braced together, as shown in the drawing, by ¼-in. by 2-in. flat bars to form the corner post.

The ram or former block is of cast iron, 7 in. by 15 in., by 12 in., and is secured to the lower end of the piston rod. It is raised and lowered by movement of the piston in the air cylinder which is controlled by a valve.



Drawing of air operated press for straightening sheets of steel cars



Consist of wrecking train stationed at a medium-sized terminal

Wrecking equipment used on English railways

Area in which wreck trains work and organization of crews closely parallels American practice

By L. P. Parker

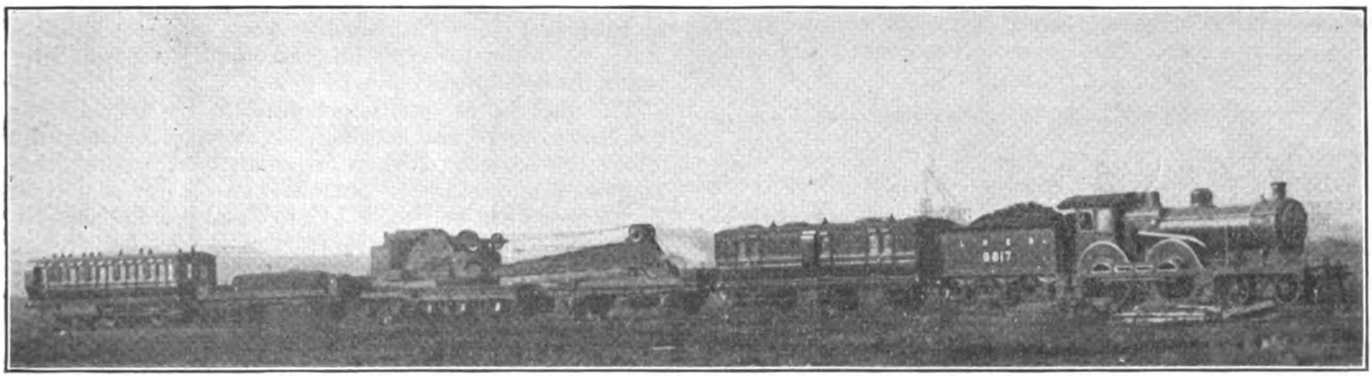
London district locomotive superintendent, London & North Eastern, England

THE organization for clearing wrecks on the English railways is in general based upon the local supervision of locomotive power, each district locomotive officer being held responsible for clearing the line after an accident within the area over which he exercises control. The farthest point of this area is rarely more than 50 miles from the district headquarters.

A wrecking train is stationed at the headquarters of each locomotive district, and at a few other selected terminals. At the most important points this train includes a steam wrecking derrick of about 40 tons capacity, while other depots have smaller derricks of 15 to 25 tons maximum lift. At a few country running sheds the hand crane still survives. In addition, there are some sheds which, although of comparatively minor importance, are either at some little distance from a district headquarters, or are liable to be called upon fairly frequently for assistance, due to small mishaps in adjacent shifting and classification yards. At these a tool car, with jack, ramps, etc., is stationed. A tool car of this type is also kept at a few of the largest terminals for use when the wreck train proper is otherwise engaged.

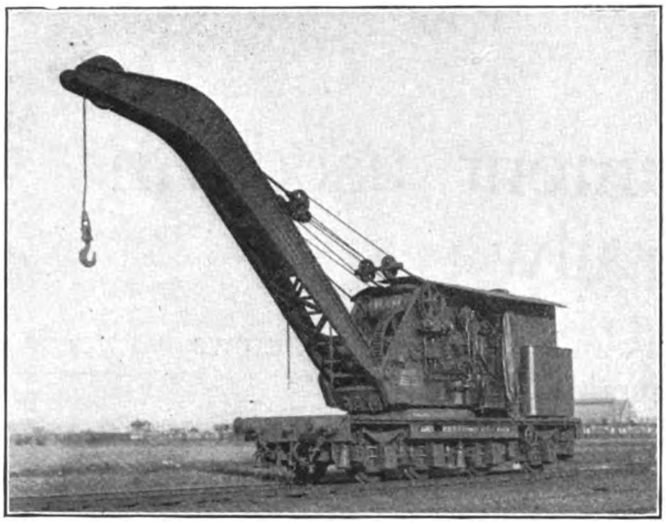
A call for assistance, in the event of a mishap, is transmitted to the headquarters of the nearest wrecking crew, and on the information contained in the message the officer in charge decides whether he can deal with the wreck with his own equipment or whether he will require assistance. This, if needed, is requested direct from the nearest point where it is available.

The largest wrecking derricks at present in use have a maximum lifting capacity of just over 40 tons at a 20-ft. radius, at which the available lift is 38 ft. Two cranes, such as this, will deal expeditiously with almost any derailment, and it is very rarely that more than one is needed. Within the last year or two, however, newly designed types of locomotive are again showing an increase in weight, although, under the English restrictions of rail-gage, height, width and axle-loads, our largest



Large wrecking crane and its supporting equipment stationed at the Stratford terminal, London

locomotives reach only a small proportion of the weight of some of the American monsters. In this connection the weight of H. N. Gresley's Pacific type express locomotive, now adopted as standard for the heaviest express passenger work on the L. & N. E., is informative. This is 332,200 lb. for engine and tender, and 206,000 lb. for the engine only. It represents the present high water mark of size in English locomotives; and, no doubt, since these heavier locomotives are becoming more numerous, it will shortly become necessary to consider the provision of wrecking derricks up to some 55 tons capacity, more especially as such a crane would be able to lift, by itself, the heaviest of the sleeping cars which are being used on the long-distance trains. At the same time it must be remembered that probably 90 per cent of all



Wrecking crane with a capacity of 23 tons

the locomotives in use in England weigh less than 80 tons each, when upcoupled from their tenders, and that a 40-ton crane will rerail these expeditiously by lifting at the two ends alternately.

Description of the derrick and auxiliary cars

One of the wrecking cranes illustrated is stationed at the Stratford (London) terminal of the London and North Eastern, a terminal to which are allocated about 450 locomotives. It may be taken as typical of the larger English wrecking cranes, and weighs 83 tons with the jib lowered and resting on the guard truck. The jib is 30 ft. long; the lift under various conditions and at varying radii is given in the following table:

Radius of jib ft.	To lift and slew with crane blocked up, tons (English)	To lift, travel and slew with counterweight in position, tons (English)	To lift, travel and slew without counterweight, tons (English)
35	16	3	2
33	19	..	..
32	..	5	..
30	24	..	5
28	27	7½	6
26	30	9	..
23	35	11	9
20	35	13	11
18	35	..	12
17	35	15	..
15	35	16½	14

This crane carries an extra 3-ton counterbalancing weight for the jib on the guard truck. This is attached under the boiler when the heavier lifts are required, but it is not used in the ordinary way. When the weight to be lifted exceeds 19 tons, the crane is secured to the rails by dog clips at each corner, and is further supported by four blocking girders, normally housed underneath the crane. These are extended, when required, by a rack and pinion, worked by a hand ratchet, and are then secured on hard wood packing by means of the jacking screws provided at their outer ends.

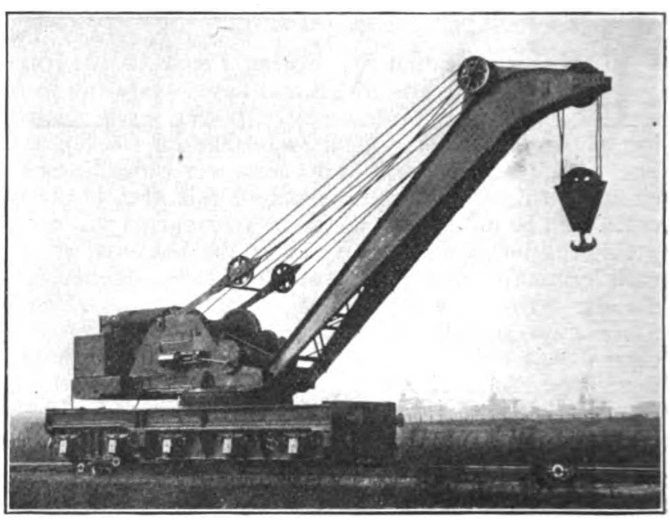
An electric light is carried at the point of the jib and another at the base. A useful feature of this crane is the eternal index plate, shown in one of the illustrations, which gives a direct reading of the normal lift at different heights of the jib. This is duplicated inside the cab, and is therefore at all times under the immediate attention both of the crane driver and also of the man directing operations on the ground.

The steam crane is always included, when at home, as part of the wreck train. This includes the crane, its guard car or cars, and either one large car or two smaller ones, giving accommodations for tools, wood packing, a riding compartment for the crew, and a private compartment for the officer in charge, who is accompanied, on important jobs, by the officers responsible for traffic arrangements and for the permanent way.

The two-car arrangement is preferred in most quarters, as both may be fitted as brake vans. One is placed at each end of the train, which is then immediately reversible without shunting—a considerable advantage under certain conditions.

The number of vehicles on the train thus varies from one, where the tool car is the only equipment, to five, made up by the crane, two guard trucks, and two cars. Exceptionally, an extra car is included, and reserved for wood packing.

The distances from the home stations at which breakdown trains do their work are short, and sleeping accommodation for the crew is not required. They are usually comfortably housed in their riding compartment, which



This wrecking crane has a capacity of 39 tons

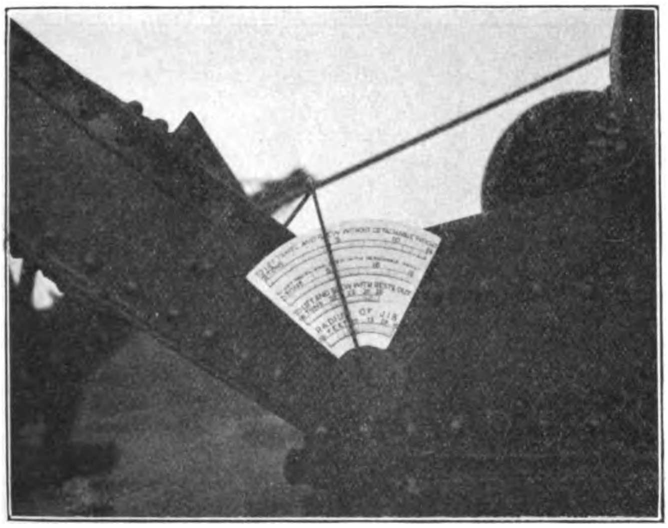
is furnished with cushioned lockers, a table, cooking stove, hot water urns, washing accommodation, and provision for drying wet clothes.

The question of food is not difficult, and it is not the practice to carry any considerable supplies on the train. There are few places where, if an accident occurs, fresh supplies cannot either be obtained close by, or sent from the nearest town or village. Coffee and biscuits are provided—and appreciated—for use on short jobs, and an emergency supply of canned meat is carried, but very seldom used. When a big wreck occurs at a distance from any town or village, a supply of fresh food is taken on board the train, if at all possible, before it leaves its home station, to cover any delay in obtaining local supplies.

Internal arrangement of the tool car

The internal arrangement of the tool cars is held to be a matter of primary importance. It is endeavored to arrange the tools so that each one is in sight and immediately accessible. To this end, boxes and lockers in the tool cars are not favored, the smaller equipment being carried in racks, clips, and trays, so that it can be seen at a glance whether anything is missing. A strip of iron plate is often laid down the middle of the car so that the heavier tools, such as jacks and ramps, can be slid, instead of carried, to the doorway, where a swing jib is fitted to lower such equipment to the ground.

Chains and slings, of which a good assortment is urgently necessary, are carried on one of the guard trucks. Wood packing, mainly in lengths of about 3 ft. by 10 in. wide and 2 in. to 4 in. thick, is made of one of the harder and tougher woods, such as elm, and is carried in considerably quantity.



Lift indicator which gives a direct reading of the normal lift at different heights of the jib. Its replica is located in the cab in front of the crane operator

The main lighting equipment consists of acetylene flares in sizes of 500 to 1,000 candle-power. "Water lights" are also occasionally used. When the job is likely to be completed in a short time the ordinary oil flares are often preferred, as they require less preparation, and can be immediately lighted and extinguished.

A complete ambulance equipment, with stretcher, splints, bandages and dressings is carried in the larger cars; where space is more limited the stretcher is sometimes omitted. Portable fire extinguishers are also usually provided.

Equipment carried in the tool cars

The equipment of tools depends to some extent on the size of the wrecking derrick, and the more ingenious devices are often met in the smaller cars, where those in charge have to rely more upon their own resources than upon the use of a big steam crane. Some appliances, however, are fairly general, including single and double ramps—rarely used if a crane is available—hydraulic jacks in capacity up to 24 or 30 tons, snatch blocks with wire cables for pulling a derailed engine by means of another on an adjacent track, forcing screws, rail stops, and so on. A compact pattern of American ball bearing mechanical jack has recently been tried and found very useful in certain circumstances.

The following list gives the chains, tools, etc., which have been found convenient at one of the larger locomotive terminals:

	Length
1—2-ton circular sling	6 ft.
1—2-ton fourfold sling	5 ft.
1—2-ton single sling	38 ft.
1—2-ton single sling	6 ft.
1—2-ton double sling	7 ft. 6 in.
9—3-ton drag chains	20 ft. to 25 ft.
1—3-ton circular sling	5 ft.
2—3-ton double slings	21 ft.
1—3-ton double sling	26 ft.
3—3-ton single slings	20 ft. to 25 ft.
1 set—4½-ton carriage slings and shackles	21 ft.
8—5-ton double slings	13 ft. to 16 ft.
1—5-ton double sling	24 ft.
3—5-ton single slings	35 ft.
3—6-ton towing chains	23 ft. to 40 ft.
4—6-ton single slings	22 ft. to 27 ft.
2—8-ton single slings	12 ft.
4—10-ton towing chains	23 ft. to 28 ft.
2—10-ton double slings	11 ft.
4—12-ton single slings	22 ft.
1 set—15-ton boiler slings	6 ft.
4—18-ton locomotive slings	18 ft.

2—10-ton lifting hooks.
1—20-ton lifting hook and links.
4—15-ton shackles.
1—18-ton shackle.
1—spreader bar with set of shackles.
6—C-links, various sizes, for attaching chains together.
4—fire extinguishers.

1—24-ton hydraulic jack	Non-traversing, with interchangeable handles.
6—20-ton hydraulic jack	
2—15-ton hydraulic jack	
3—12-ton hydraulic jack	

2—25-ton ratchet jacks.
1—small screw jack.
1—pair double ramps.
1—pair single ramps.
2—clips for withdrawing intermediate drawbar pins.
3—rail clips for locating engine wheels when rerailing with jacks.
1—rail clip for jack when pushing vehicles sideways.
6—adjustable screw hangers for attaching truck to car body when lifting to rerail.
1—ladder.
2—pickaxes.
1—spade.
6—shovels.
2—axes.
2—crosscut saws.
1—hand saw.
1—hack saw with 6 blades.
6—files and handles.
5—long chisel bars.
1—dozen flat chisels.
4—round nose chisels.
2—cross cut chisels.
3—long pin punches.
6—short pin punches.
9—cold sets.
9—rod punches.
3—short cotter drifts.
3—long cotter drifts.
4—hand hammers.
8—flogging hammers.
1—lead hammer.
4—screw drivers.
5—long pinch bars.
10—short tommy bars.
6—steel wedges.
1—samson for straightening car axle guards.
6—oil bottles, various sizes.
7—oil feeders.
1—syringe.
40—spanner wrenches, various sizes.
1—oxy-acetylene cutting plant complete.
4—acetylene flare lights.
4—acetylene hand lamps.
4—large oil torch lamps.
4—small oil torch lamps.
3—tail lamps.
2—tender draw bars.
2—locomotive draw bars.
2—intermediate drawbars and pins.
12—couplings, various types.
16—iron packing pieces for securing a broken locomotive axle.
8—car runners, for replacing broken axle boxes.
4—plates and studs for securing broken truck springs.
3—trolleys for temporary replacement of damaged car or pony trucks.
16—steel shackles, various sizes.
1—steel straight edge.
3—wheel gages.
1—rail gage with spirit level.
2—flags (red and green).
1—66-ft. tape measure.
1—2-ft. rule.
6—binding ropes, various lengths.
150—pieces elm packing, various lengths and thicknesses.
100—wood wedges.
2—coffee urns.
1—copper can.
1—dozen enamel cups.
1—dozen enamel plates.
1—dozen large knives.
1—dozen forks.
1—dozen teaspoons.
14 lb.—canned meat.
Coffee, biscuits, sugar.
Ambulance cupboard with dressings and set of bandages.
1—set of splints.
1—stretcher.
1—bowl and sponge.
1—pair of scissors.

The foregoing equipment, as will be seen, is that of a wreck train where reliance is placed for rerailing mainly upon the use of a large wrecking derrick. At a smaller terminal the equipment of chains and slings is much less complete, but the means for rerailing by dragging, ramping, and jacking, is more extensive. In such cases considerable use is made of traversing hydraulic jacks in sizes up to 35 tons, and of other appliances, such as Pearson car-replacing jacks, slewing tackle, and so on.

The organization of the wrecking crew

The exact size and composition of a wrecking crew depends on the importance of the terminal and to some extent on the personal predilections of the officer in charge. A complete crew usually contains 12 men, all of whom are called only for serious accidents. The generally accepted number for a crew for ordinary work is eight, excluding the foreman, who is almost invariably a skilled locomotive repairman; these eight men usually include a car repairman, a locomotive repairman, and occasionally a blacksmith, the remainder of the crew

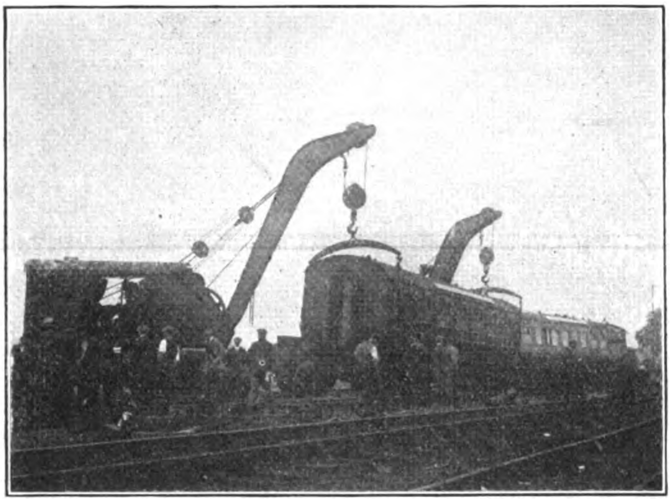
being composed entirely of picked and trained laborers.

The wrecking crew is not wholly employed on that work, which is nowhere sufficiently continuous to keep it fully occupied at all times. At the smaller terminals, the men are essentially a part of the repair shop organizations, who are called away from their ordinary work when required for breakdowns occurring during their tour of duty, and sent for by means of bicycle messengers, when needed at other times. They are required to live within a very short distance from the terminal.

At the larger terminals there are two main schemes of organization. Under one scheme, the crew is divided up among the shifts which come on duty at intervals during the 24 hours, so that when a call is received bells can be rung simultaneously in all parts of the terminal, and the wreck train manned within a very few minutes. This is the best way, so far as extreme promptitude is concerned, but has the disadvantage that either a large total number of trained men must be available, or the crew must be completed with odd men from the running shed.

Under the other scheme, the men are placed on duty at a regular time each day, and have definite places in the repair shop organization; but they are primarily regarded as members of the wreck crew, and attend all calls whenever they occur. By this method the same individuals attend all accidents, and have more opportunity to become highly skilled at their work. The train does not get away quite so quickly, but is expected to leave its terminal within 30 minutes from the receipt of the call. An improvement is frequently made on this period during ordinary working hours, and it is not very often exceeded at other times.

At the main terminal under the charge of the writer, the members of the wreck crew live close by in houses



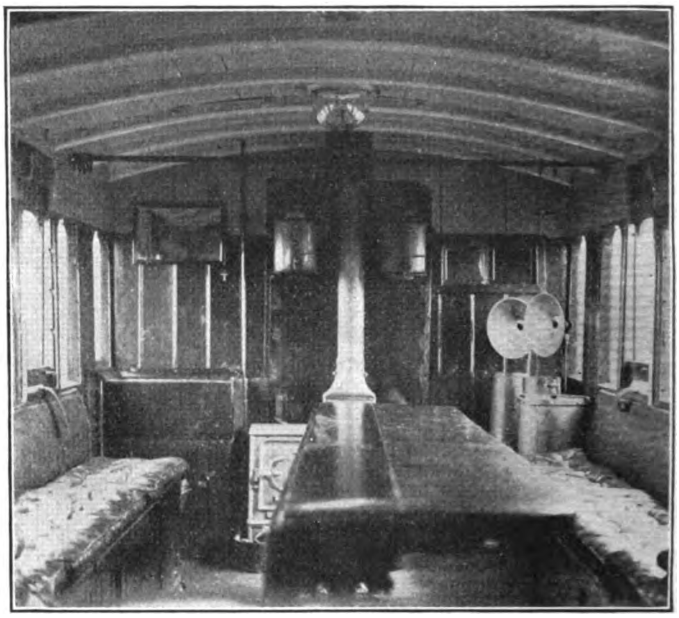
Two English wrecking cranes in action

owned by the railway company. These houses are connected to the enginehouse telegraph office by an electric bell, so that, if they are not already on duty, a call can be transmitted to the men almost simultaneously with the receipt of the message. This crew consists entirely of selected and trained laborers, and, by constant practice, gives results at least as good as those obtained by crews including skilled mechanics.

There are very few places where a foreman is engaged and occupied mainly as a wrecking foreman. Where this is the case, he is invariably a skilled locomotive repairman, and may fill in his time by the supervision of coaling arrangements and yard laborers at the main terminal. More usually, the head foreman in charge of locomotive repairs acts also as foreman of the wrecking crew. Another arrangement, less popular than the last mentioned, is for the foreman of the locomotive repairmen to attend to locomotive derailments and serious accidents, and for the foreman of the car repairers to deal with car derailments. The locomotive officer in charge of the district or his principal assistant invariably attend all calls excepting those for mishaps in shifting yards.

How the wrecking crew is paid

The payment to the crew of the accident train is regulated by the various national agreements and awards which govern the conditions of employment of English railwaymen. Under these agreements the manual workers on the railways are divided into two main classes. On the one hand are those engaged in the engineering trades—skilled mechanics, their helpers and laborers.



Riding compartment for the wrecking crew

The rate of payment to any of these men included in a wreck train crew is governed by Award (No. 728) of the Industrial Court, which, after laying down the standard rates for all the engineering staff in every railway center, states that:

1—All ordinary time worked between 6 a.m. and 6 p.m. is paid at the standard rate.
2—Rate and a quarter is paid for the first two hours overtime between 6 a.m. and 6 p.m.
3—Rate and a half is paid for all further overtime worked between 6 a.m. and 6 p.m.
4—Rate and a third is paid for all ordinary time between 6 p.m. and 6 a.m.
5—Rate and a half is paid for all overtime worked between 6 p.m. and 6 a.m.
6—Double rate is paid for all time worked between midnight Saturday and midnight Sunday.
7—The appropriate day or night overtime rate is paid to men called on duty during the eight hours rest following their ordinary working hours.

The rate of payment to men of the conciliation grades included in a wrecking crew is governed by a series of national agreements made between the companies and the trade unions and the arrangements for payment of these men are perhaps slightly simpler than in the case of the mechanical staff:

1—All ordinary time worked between 4 a.m. and 10 p.m. is paid at the standard rate.
2—Rate and a quarter is paid for all overtime between 4 a.m.

and 10 p.m., and also for all ordinary time worked between 10 p.m. and 4 a.m.

3—Rate and a half is paid for all overtime worked between 10 p.m. and 4 a.m., and also for all time worked between midnight Saturday and midnight Sunday.

4—The appropriate day or night overtime rate is paid to men called on duty for four hours or less.

5—Emergency duty exceeding four hours is treated as one of the six regular weekly turns, and is paid accordingly, if the man is thereby unfitted to take up his succeeding ordinary turn of duty.

The minimum payment made to a man of any grade when called specially on duty is that for two hours at his ordinary rate; and in addition to this, or to the payment to which he is entitled under the arrangements above cited, a special allowance is made for each call, equal, at present, to one third of the standard daily wage for a laborer.

It will be seen that where calls for wrecking duties are frequent, the work is well paid, in comparison with that of an ordinary laborer; and that is as it should be, for the team work of a well trained and competent crew is a pleasure to see, and their value to the responsible officer is beyond rubies.

Hand loops for carrying heavy metal

By Joseph C. Coyle

IN railroad work, as well as any other industry, little kinks, that make the work easier for the men, save money for the company as well.

The 5-in. by 9-in. journal brasses weigh about 22 lb. each, and the small size and the shape, make them rather

An easy way of carrying journal brasses

hard to carry. At the same time, if only one or two brasses are required for the job in hand, a workman does not care to bother with a wheelbarrow.

At the Denver shops of the Denver & Rio Grande Western the handling of brasses is made easy by the use of spliced rope loops, which enable the workman to carry two of the brasses with little effort. Any other heavy piece of metal may be carried with these loops providing the surface is uneven enough to prevent slipping.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Temporary repairs made to cast steel bolsters

On May 15, 1923, the Indiana Harbor Belt Line rendered a bill of $390.67 to the St. Louis-San Francisco for repairing a broken cast steel truck bolster on St. L.-S. F. car No. 77466. In making repairs the handling line applied four patches and secured them with 32 rivets for which it made no charge as they were temporary repairs. The handling line stated that the bolster was also bent, which necessitated a blacksmith labor charge of $11.05 for straightening. It also charged 5.2 hours labor for R. & R. the bolster, 1 hr. for raising the car, 48 cents for grip nuts and 119 lb. of box and column bolts. The handling line later refunded $5.72 which covered the labor charge for R. & R. the bolster, but it refused to cancel the other charges. The handling line made the temporary repairs in accordance with A. R. A. Rule 17 and based its charges for labor for straightening the bent bolster on the interpretation of Item 421-A of Rule 107. The car owner contended that the handling line should have either welded the bolster according to Rule 23 or applied a new one to justify any charges whatever.

In rendering its decision the Arbitration Committee stated that, "The Indiana Harbor Belt Line should cancel all charges in this case as the repairs were of a temporary nature. The objection of the St. Louis-San Francisco is sustained."—*Case No.* 1363, ***Indiana Harbor Belt vs.*** *St. Louis-San Francisco.*

Responsibility for car damage when the brake chain fails

On July 20, 1924, while C. Y. C. X. tank car No. 951 was being switched in the yards of the Missouri-Kansas-Texas, the brake chain broke, allowing the tank car to get away and strike M.-K.-T. flat car, No. 113079, knocking the coupler down and breaking the end sills of the flat car, bending the coupler and breaking the end sills, two running boards and the striking plate of the tank car, and causing the tank to leak so that it was necessary to transfer the load to another car. The Conley Tank Car Company stated that the damage to the car was M.-K.-T. responsibility according to Rule 3 on page 3 of Supplement No. 1, A. R. A. Code of Rules, effective July 1, 1924, contending that the M.-K.-T. was negligent in the inspection of the car and that the accident was caused by a worn link in a chain caused by a bent brake rod bracket which permitted the chain to drag on a wheel. The M.-K.-T. stated that the car was given the usual inspection and that the car, when being switched over the hump, was protected by a car rider and that when an attempt was made to control the car,

the brake chain broke which prohibited the rider from controlling the car, thus resulting in the car being damaged which under these conditions is the owner's responsibility.

The Arbitration Committee based its findings on Decision 1323, which reads as follows: "The evidence shows that the handling line provided rider protection and that every reasonable effort was made to protect the car, therefore, the car owner is responsible."—*Case No.* 1364, *Conley Tank Car Company vs. Missouri-Kansas-Texas.*

Responsibility for air hose torn off in switching service

On April 10, 1924, the Chicago Junction Railway put a new 1⅜-in. air hose on the "B" end of Texas & Pacific car No. 32099 for which it billed the car owner for $1.75. The handling line stated that the air hose was torn off because it would not automatically uncouple at the time the car was switched, thus being an owner's defect, as outlined in Rule 58. The car owner contended that the air hose was torn off because the cars were pulled apart without uncoupling the hose by hand, which practice it considered unfair usage, making the replacement handling line responsibility.

In rendering its decisions the Arbitration Committee stated that, "Inasmuch as the air brake hose was not missing complete, the car owner is responsible under Rule 43. The bill is, therefore, sustained."—*Case No.* 1362, *Texas & Pacific vs. Chicago Junction.*

Cars damaged by trucks pulling out

The Illinois Central reported on November 12, 1923, to the car owner, the destruction of Texas & Pacific box car No. 7021. This car was of 60,000 lb. capacity, and was of good construction, equipped with Cardwell friction draft gear and Universal cast steel draft arms. The Illinois Central later advised, on December 31, 1923, that this car had not been destroyed, but had been given necessary repairs in its shops for which it rendered a bill for the amount of $180.31. The Texas and Pacific sent a representative to the Illinois Central shops to investigate the damage to the car, as a result of which the car owner refused to accept he bill for repairs, claiming handling line responsibility because of the trucks being pulled out and allowing the car body to drop to the rails. Furthermore, the car owner did not agree with the Illinois Central that the physical condition of the car was responsible for its being damaged because the rules allow the receiving line to reject any car whether empty or loaded that in its opinion is unsafe for handling. If this car had been unsafe, the handling line could have refused it in interchange. Furthermore, the original record of the handling line showed that the car was decayed, which, the owner maintained was proved to be in error by the handling line's wreck report, believed to be the only source from which the handling line could have obtained a report of the actual physical condition of the car to substantiate its claim.

On June 28, 1923, the Illinois Central billed the Texas & Pacific for $163.20 for repairs to T. & P. box car No. 8362 which was of the same construction as the car above mentioned. Here again the T. & P. refused to accept the bill for repairs, under the claim of unfair usage resulting from the trucks being pulled out and allowing the car body to drop to the rails. In this case the car owner claimed that if the car had had rotten sills and defects as claimed by the handling line, it would be reasonable to assume that the I. C. would have made the necessary repairs while the car was on its repair track, under Rule 120, which allows the handling line to expend $225 labor without consulting the car owner, instead of waiting until the trucks pulled out. In both cases the handling line defended its position by stating that the two cars failed on account of their age and poor physical condition, and not because of unfair usage.

In rendering its decision the Arbitration Committee stated that "the handling line is responsible in both cases. Decisions 1186, 1236 and 1342 apply."—*Case No.* 1366, *Texas & Pacific vs. Illinois Central.*

Floor renewed on defect card to replace sills

On December 26, 1922, Pere Marquette car No. 12911 was derailed while on the Detroit & Toledo Shore Line property. As a result of the derailment, the handling line issued a defect card for the following damages: one center sill, one intermediate sill, one side sill and one sub sill broken. "A" end; one intermediate sill broken, "B" end. After the car was repaired, the car owner billed the handling line for the renewal of the floor in the car. The handling line took exceptions to the billing for the flooring, claiming that the defect card did not authorize it. The Pere Marquette stated that the defect card correctly omitted flooring as the damage to it was not directly due to the derailment, but was an indirect result of the derailment, it being necessary to damage all the flooring to remove the four full length longitudinal sills.

In rendering its decision, the Arbitration Committee stated that, "The statement of the Pere Marquette as to the necessity for renewing the entire floor on this car is in conflict with common practice in making repair of this character. The ordinary construction of wooden underframe gondolas is such as to permit the pulling down of longitudinal sills from the floor to renew them with a small amount of damage to the floor. The objection of the Detroit & Toledo Shore Line is sustained."—*Case No.* 1360, *Pere Marquette vs. Detroit & Toledo Shore Line.*

Time limit for presenting joint evidence

On May 15, 1922, the Louisville & Nashville made the following repairs to C. & W. C. box car No. 1650:

Repairs made	Why made
1 Door hasp strap	Broken
3 Door hasp strap bolts, R. & R.	Necessary
W.A.B.F-36 triple valve R. & R. & Cyl. c.o.t.s. per Rule 60	FL-3-16-21 Out of date

On July 10, 1923, the C. & W. C. secured joint evidence showing that the car was equipped with Westinghouse H-1 triple valve, that Westinghouse K-1 triple valve was standard and that the car was stenciled on both sides to show that Westinghouse K-1 triple was standard, the joint evidence further showing that the Westinghouse H-1 triple was applied by the L. & N. on May 15, 1922. Joint evidence, together with billing repair card, was furnished the L. & N. The latter declined to furnish a defect card for the wrong triple valve because the car was first received home December 1, 1922, and the joint evidence was not secured within 90 days as required by Rule 12. The C. & W. C. contended that a defect card should have been furnished in accordance with Rule 87, for if the L. & N. had complied with this rule when the wrong repairs were made, attaching a defect card at that time to the wrong triple valve, it could not have raised the technical point of time limit.

The following decision was rendered by the Arbitration Committee: The contention of the Louisville & Nashville is sustained. Decisions 1270, 1285 and 1351 apply.—*Case No.* 1361, *Charleston & Western Carolina vs. Louisville & Nashville.*

Interchange car inspectors and car foremen to meet

Opening session at Chicago to be addressed by R. H. Aishton—25th annual meeting

THE members of the Chief Interchange Car Inspectors' & Car Foremen's Association will hold their 25th annual convention at the Hotel Sherman, Chicago, September 21 to 23, inclusive. While there is not much change in the general character of subjects considered by this association, which include freight claim prevention, car shop practices, interchange rules, loading rules and billing, these subjects are all of such vital importance and have such a direct effect on the net earnings of the railroads that they may well be repeated. Each year's discussion brings added experience in the science of handling material and men, which is one of the most important factors in the work of car inspectors and car foremen.

Following the opening address by R. H. Aishton, president of the American Railway Association, the subject of freight claim prevention will be discussed by a representative of the A.R.A., followed by a paper on wheel shop practice, which practice lends itself to an organization on a productive basis, perhaps better than that of any other department of railroad mechanicai maintenance work.

Col. B. W. Dunn, chief inspector of the Bureau of Explosives, will address the association, and the subjects of interchange difficulties at small points, simultaneous preparation of billing repair cards and record of repairs, and progressive rebuilding of house cars, will be presented by individual speakers.

The Chief Interchange Car Inspectors' & Car Foremen's Association has increased in convention attendance particularly in the last few years, and this year should be no exception. It is hoped that few members will miss attending and thereby forego the opportunity to increase in knowledge of methods which promote more efficient handling of railroad car equipment. Following is the convention program.

J. P. Elliot (Terminal Railroad Association) President

B. F. Jamison (Southern) First vice-president

E. R. Campbell (Great Northern) 3rd Vice-president

A. S. Sternberg (Belt Rwy. of Chicago) Secretary

September 21

Meeting called to order at 10:00 a. m. Daylight saving time.
Address By: R. H. Aishton.
Address By: President W. P. Elliot.
Report of secretary and treasurer.
Report of entertainment committee.
Report of membership committee.
Address: "Freight claim prevention" by Mr. Joe Marshal, special representative, American Railway Association.
Individual Paper: Subject "Handling wheels and axles at wheel shops" by W. T. Westall, assistant district master car builder, N. Y. C.

Afternoon Session at 2:00 p. m.

Address: By Colonel B. W. Dunn, chief inspector bureau of explosives.
Individual Paper: Round table discussions. Subject "The trouble of the small interchange points and the remedy," by John Rauscher, C. I. I., Cincinnati, Ohio.
Individual Paper: "Method of preparing A. R. A. billing repair cards and record of repairs simultaneously at the car," by C. C. Hennessy, head A. R. A. clerk, C. C. C. & St. L.
Individual Paper: "Progressive rebuilding of house cars," by C. M. Hitch, district master car builder, B. & O.
Remarks: By visitors.

September 22; morning session at 9:00 a. m.

Discussion of A. R. A. rules of interchange.
Remarks: By visitors.

Afternoon Session at 2:00 p. m.

Continued discussion of A. R. A. rules of interchange.

September 23; morning session at 9:00 a. m.

Discussion on the subject: "Cars condemned for transfer at large terminals and methods used to get cars through by repairing without the necessity of transferring."
Remarks: By visitors.
Report: "Question Box Committee."
Remarks: By visitors.

Afternoon Session at 2:00 p. m.

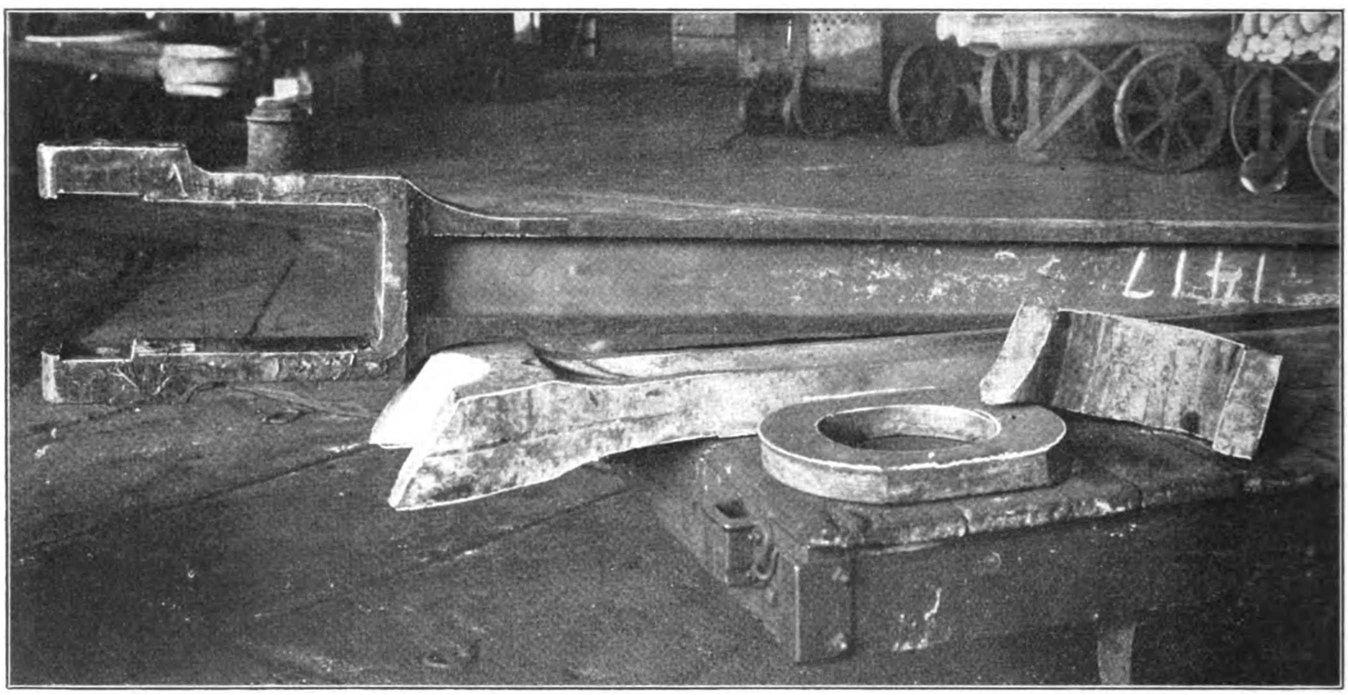
Election of officers.
Remarks by members and visitors.
Adjournment.

Main rod reclamation at Silvis shops

Fork and strap end rods converted to solid back end type by simple and effective method

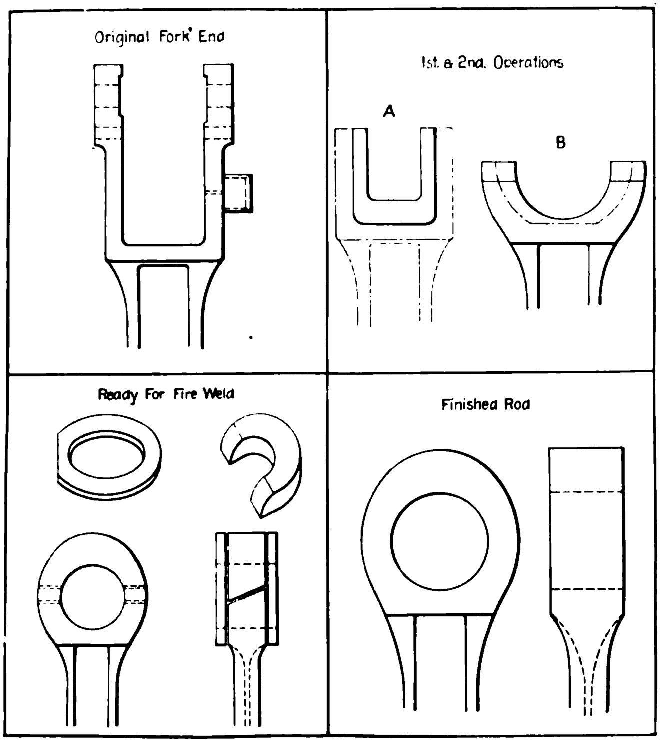
FAVORABLE results with the floating bushing, solid back end type of main rod induced the Chicago, Rock Island & Pacific about a year ago to consider the conversion of fork and strap end main rods to the solid back end type, particularly in cases where bolt holes were worn to the limit and the rods would otherwise be scrapped. After some experiments, a method was developed at the system shops, Silvis, Ill., which proved both simple and effective and produced essentially new solid back end main rods at a fraction of the cost of forging new rods from billets. As shown in the tables the cost of converting one fork end type rod, including labor, material and a generous pro rata for shop overhead expense was but $32.91; for the strap end type, $66.69; the difference in cost being accounted for largely by additional forging in the case of strap end rods.

Since August, 1925, this conversion work has been carried out in the case of 57 fork end rods and 128 strap end rods. A real tribute to the practicability and effectiveness of the new method is afforded by the fact that these rods have been in service, in some cases for 12 months, without failure or trouble of any kind. A program is now being worked out whereby heavy passenger



Fork end main rod before and after preparation for welding to form solid end type

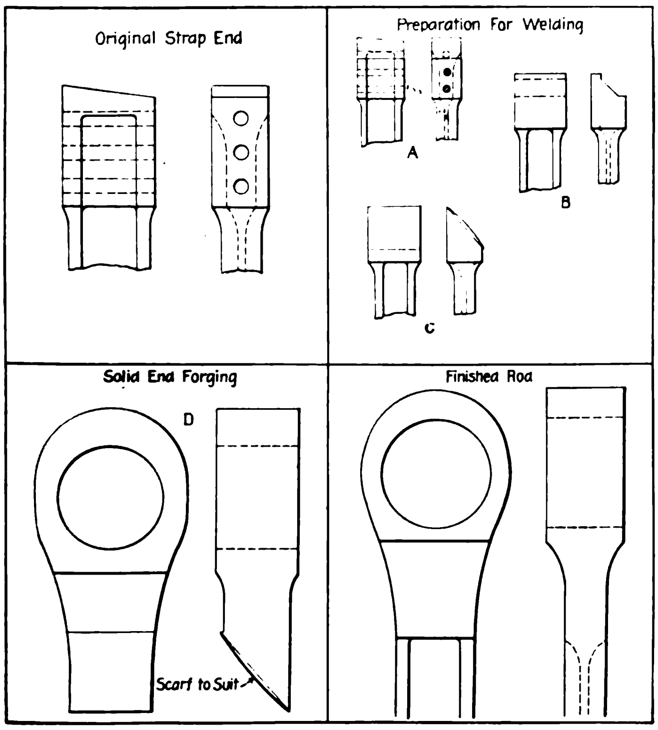
and freight power on the Rock Island will be equipped with solid back end main rods as locomotives pass through the shops for general repairs.



Detail operations in converting fork to solid end main rods

Converting the fork end type

The method used in converting the fork end type of main rod is shown in one of the drawings, the first

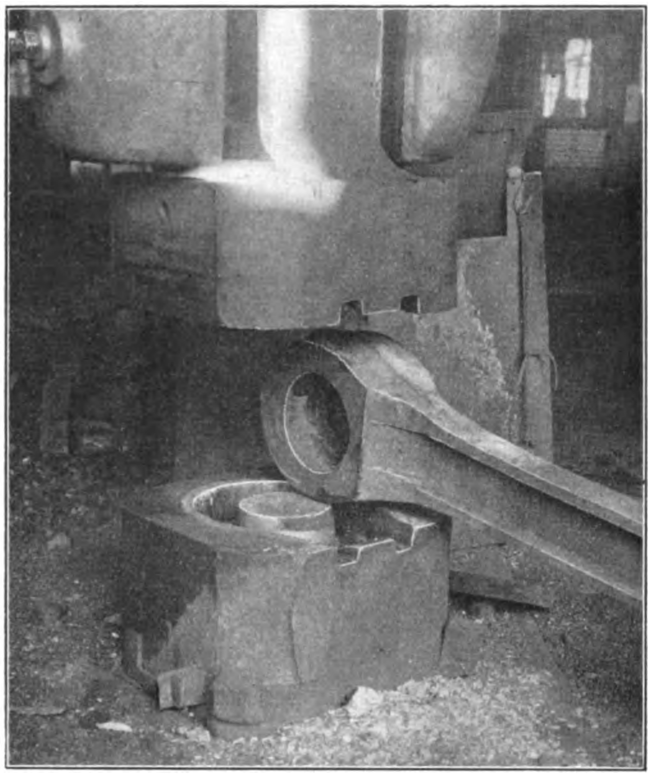


Detail operations in converting strap to solid end main rods

operation, indicated at *A*, consisting of removing the oil cup and cutting the fork ends to the proper length with an oxy-acetylene cutting torch. A U-shaped piece, also shown at *A*, is formed on a bulldozer and fitted in the fork end, the entire end being heated to a welding temperature and welded and formed with dies in an Ajax forging machine to the shape shown at *B*. In this forging operation, the rod is back stopped and the metal must take the shape of the die. It will be noted that the two ends are scarfed for welding to the outer section of the new rod.

A forging is made and bent on the bulldozer, as shown at *C*, and two plates *D* punched, these parts being tack welded to the original main rod. A welding heat is taken on the entire assembly and the weld is made in special dies used under a 1500-lb. Chambersburg steam hammer. The dies and a finished rod are shown in one of the views.

The detailed cost of forging operations in converting the rod is shown in one of the tables as is also the cost of straightening, checking for length and annealing. The



Dies for forming solid end main rods under Chambersburg 1,500-lb. steam hammer

rod is sent to the machine shop, where it is milled on two faces, laid out, bored and finish machined.

A steam hammer heavier than 1500 lb. may be used for this work, but a lighter one would hardly be satisfactory, especially for large rods. To sets of dies have been made to cover the five different classes of Rock Island fork end main rods and in the case of the strap end rods, four sets of dies have been designed which cover 15 motive power classes.

Method used with strap end rods

In the case of strap end main rods, the method of converting to the solid back end type is illustrated in the other drawing. The bolt holes are plugged with the original bolts and the rod cut off to the proper length as shown at *A*, to permit a good scarf on the new solid back end. The rod is then upset in a bulldozer as shown at *B*, the particular shape of end indicated having proven most satisfactory as a seat for the header. (With a straight taper, operation of the header results in too

much wedging action and not enough upsetting.) The main rod is scarfed under the steam hammer, as shown at *C*. The new end for the main rod, forged from billet steel as shown at *D*, is scarfed to suit the rod end. The new solid end forging is then welded to the original main rod in three heats, the center being welded first and then the scarf welded on each side. The rod is straightened, tested for length, annealed and finished in the machine shop, as in the case of the fork end rod.

Cost of converting fork end to solid end main rod

Blacksmith Shop—	
Up-set fork end of main rod for converting	$2.60
Burn and assembly	2.70
Convert fork end to solid end	5.75
Straighten and check for length	1.90
Anneal	1.62
Pro rata 41.57 per cent	$6.06
Machine Shop—	
Slab mill	$2.16
Layout	.36
Bore	1.44
End mill	1.08
	$5.04
Pro rata 48 per cent	2.41
Total labor	19.61
Total pro rata	8.47
Grand total labor	28.08
Material—	
Hammered iron—245 lb. at 1.84 cwt	$4.51
Seven per cent store expense	.32
Total material	$4.83
Total cost one rod	32.91

Cost of Converting Strap to Solid End Main Rods

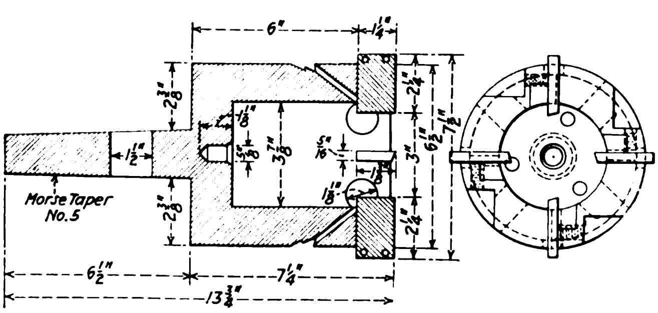
Blacksmith Shop—	
Up-set for converting	$2.60
Manufacture head	9.48
Weld, straighten and check for length	21.85
	$33.93
Pro rata 46.81 per cent	15.88
Machine Shop—	
Slab mill	$2.52
Layout	.36
Bore	1.44
End mill	2.35
	$6.67
Pro rata 37.57	2.51
Total direct labor	40.60
Total pro rata	18.39
Total labor	$58.99
Material—	
Soft steel 320 lb. at 2.25 cwt	$7.20
Seven per cent store expense	.50
Total material	$7.70
Total cost one rod	66.69

Tool for truing up eccentric crank arms

By J. H. Hahn

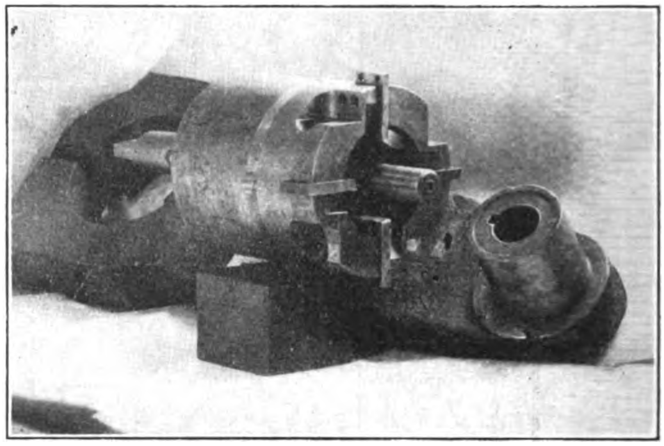
Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

It has been the practice at this shop in the past to machine, on a boring mill, the boss on eccentric crank arms. Doing such work on this type of machine not only takes unnecessary time but also ties up an expensive machine. In order to eliminate this method, a special tool in the form of a hollow mill was designed to be used on a drilling machine.



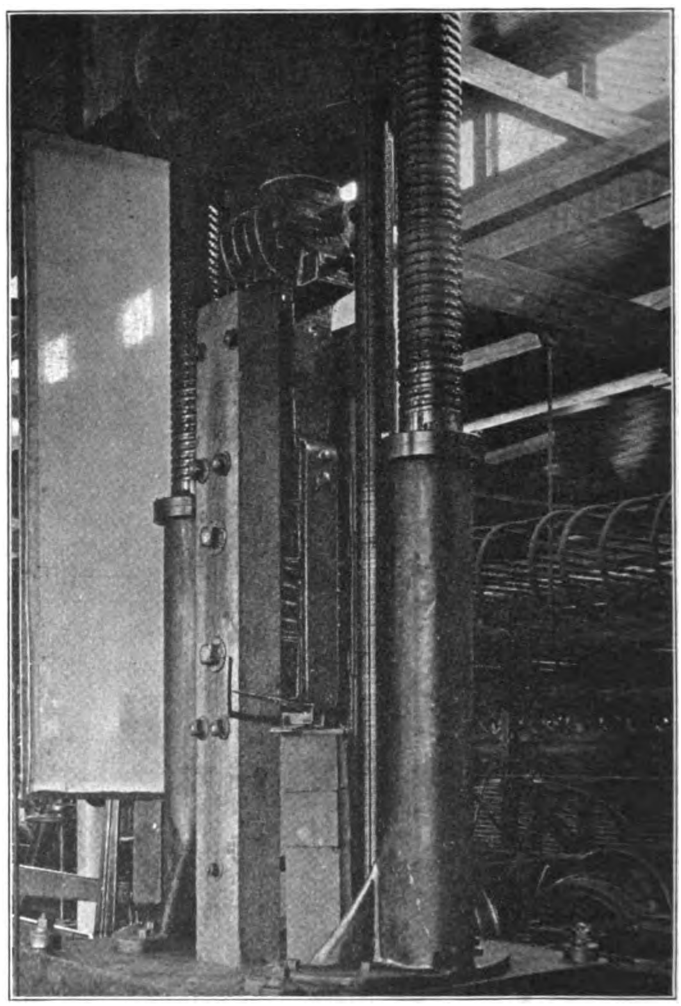
Details of the cutter head

The Morse taper No. 5 shank and the body of the tool is made in one piece. The outer circumference of the tool is designed to hold four cutters each of which



Hollow mill for truing eccentric crank arms

are held firmly in place by two set screws. These cutters are made from discarded Acme diehead cutters. As may be seen from the drawing shown in one of the accompanying illustrations, it is simple and inexpensive to make.



Compression test of a draft gear in a 300,000 lb. Riehle testing machine at Purdue University

Master blacksmiths meet at Cleveland

Improved equipment necessary for modern blacksmith work—Importance of up-to-date heat treating methods emphasized

THE thirtieth annual convention of the International Railway Master Blacksmiths' Association was held at the Hotel Winton, Cleveland, Ohio, August 17 to 19, 1926. There were over two hundred members, guests and supply men registered. With the exception of the last afternoon of the convention, during which an inspection trip was made through the plant of the Ajax Manufacturing Company, Euclid, Ohio, the entire time was devoted to the presentation and discussion of committee reports on autogenous welding, carbon and high speed steel, drop and machine forging, draw bars and draw bar pins, frame making and repairing, heat treatment of steel and iron, reclamation, spring making and repairing, safety first and tools and formers.

Practically all of the speakers emphasized the necessity of improved blacksmith shop equipment in order to economically handle the higher class of work demanded in the maintenance of modern motive power. In the discussion of the reports, especial interest was evidenced on the subject of heat treatment of steel and the making of locomotive springs.

Recognition was taken of the important fact that increasing use of high grade alloy steels in locomotive parts necessitates the use of properly heat treating these parts in order to obtain full advantage of the better grade of steel used.

The members voted to hold the 1927 convention in Buffalo. The following officers were elected to serve for 1927: President, L. C. H. Weideman, C. C. C. & St. L., Beech Grove, Ind.; First Vice-president, W. W. Shackford, A. C. L., Waycross, Ga.; Second Vice-president, J. J. Haggerty, N. Y. C., Albany, N. Y.; Secretary-Treasurer, W. J. Mayer, Michigan Central, Detroit, Mich.

The following are abstracts of several of the committee reports presented:

H. W. Loughridge (P. & L. E.)
President

L. C. H. Weideman (Big Four)
1st Vice-president

W. J. Mayer (M. C.)
Secretary

Autogenous welding

By Lewis Woodrum
Chesapeake & Ohio, Huntington, W. Va.

The term autogenous welding in its present day sense is a general term applying to any method of welding made by a fusion process where the metals to be welded are heated to such a temperature that they will flow together and make a weld without force or pressure. The electric, oxy-acetylene and thermit welding are most common.

The first step in welding is a properly designed joint; not only for strength, but to insure good workmanship. It is not fair to expect any welder, no matter how competent he may be, to make good weld on a poorly designed joint. The essential feature of a good joint is the 90 deg. vee, having space between the points of the vee at least as large as the size wire you are going to weld with. This will allow the welder to get to the bottom of the vee and obtain perfect fusion. Proper fusion of the base metal and the depositing of good weld metal is most important in welding. Use of the proper welding material is also important.

The first thing to be determined is that the welder deposits sound weld metal; in order to do this he must be using a neutral flame. (Avoid using an oxidizing or carbonizing flame). It is also important that he hold the welding torch the proper distance from the work and fill in the weld metal in the proper manner into the molten bath.

It is easy to determine whether these steps are being correctly done by having the operator weld some test pieces. Then bend the pieces in the weld and if the weld breaks you can readily see whether you are getting perfect fusion or if the weld metal is deposited in solid mass or in flakes or layers. There are several important points

to be carried out in welding steel: Use correct flame (neutral flame). Weld with the non-luminous mantle just touching the metal. Heat the steel only just enough to weld it, any more heat is detrimental to the weld and is only a waste of gas. Keep the metal in a molten state as short a time as possible and avoid bringing weld metal to the melting point the second time if possible. Hold filler rods in contact with the weld while adding metal. Hold the welding torch comparatively quiet and work the filler rod. Swing the flame on and off the molten metal, allowing the oxygen in the air to come in contact with it which results in a certain amount of oxidation.

Welding cast iron.—Prepare the weld about the same as you would for welding steel. If the job requires it, preheat it to a dark red. Apply the flame to the bottom of the vee, being sure you fuse the bottom of the vee first and at the same time heat the sides of the vee up to a fusing point, then apply the filler rods, breaking up the oxide flux and raising the impurities with the filler rod. Always be sure to raise all the impurities to the top of the weld where you can float them off. Do not push the impurities to the edge of weld and leave them there as it will cause hard spots. Do not hold the flame on one spot any longer than necessary to fuse it for by doing so you are liable to burn out properties impossible to replace.

The cooling process of cast iron weld.—This is a very important part in cast iron welding after the weld is finished. Heat to a dark red, cover up and allow to cool slowly. If the method as stated above in welding is carried out and the proper care taken in annealing welds after being finished a good job is assured.

The use of tobin bronze.—Tobin bronze is playing a large part in welding on the Chesapeake & Ohio. We have brazed a number of cracked and broken cylinders with very good results. For instance, on running repairs, when we didn't have time to build a furnace around the cylinder and weld with cast iron and take time to allow it to cool slowly we sometimes place a few studs in the vee to tie to—depending on the nature of the break.

We do a lot of brazing on link motion on members having jaws and eye connections such as eccentric rods, radius rods, combination levers, union links, etc. We also build up the sides of main rod-ends to make up the lateral.

Electric welding.—Electric welding is an important factor in the upkeep of the power and reclaiming of numerous parts. We use both methods of electric welding—the metallic arc-welding and carbon arc-welding.

As in other welding it is important to prepare the job properly to be welded. The main points are: First, proper preparation of metal to be welded; second, selection of a proper electrode; third, proper adjustment of current; fourth, holding proper arc length while welding; fifth, proper filling of welded metal; and sixth, heat treatment of welds.

A skillful operator normally maintains a short arc, the result is less material wasted and a better weld obtained due to improved fusion, decreased slag contents and a weld free from porosity.

In electric welding it is important to have the vees chipped clean and free from all scale or oxide and keep the weld brushed out clean at all times.

Frame welding.—We do quite a lot of frame welding with the electric process and have had wonderful results. We have some welds that have been running since 1914. When we weld broken frames the first thing is to see that the frame is properly lined up. Then we tram the frame to keep the proper length. They are vee'd from both sides whenever possible and all scale or oxide chipped off the face of the vee. The break is then either jacked apart or the opposite member heated enough to take care of contraction of the weld. The amount, of course, depends on the size of the frame. Next place a ¼-in. or ⅜-in. plate under the vee which is to extend 1 in. past the corner of vee and about ⅜ in. on each side of the frame. Weld both ends of the plate solid to the frame and then fill up the vee. Use an air hammer and a dull roughing tool, to clean each layer as the weld advances. This does two things, it removes the scale that you could not get rid of by brushing and at the same time stretches and packs the metal by relieving some of the strain.

Welding guides.—We have found by past practice that we get the best wear and quickest job by welding guides with the carbon arc process. Edge up the guides on the worn corners with the metallic arc, then fill in the worn sides with ½-in. filler rods using a carbon arc. This is much cheaper and quicker than either acetylene or metallic arc process.

Carbon and high speed steel

By C. E. Davis

Blacksmith foreman, New York, Chicago & St. Louis

Tool steels fall naturally into two classes, namely, plain carbon and alloy.

Plain carbon steels are primarily mixtures of carbon and iron with minor elements present, such as phosphorus, manganese, sulphur, and silicon. Very small percentages of oxygen, hydrogen, and nitrogen are present, but these last three are impurities and occur only in traces and may be disregarded in standard steel.

The average analysis of all tool steels are covered by the following table:

Carbon	0.45—1.65	per cent
Manganese	0.20—0.50	per cent
Sulphur	0.030 max.	per cent
Phosphorus	0.030 max.	per cent
Silicon	0.10-0.30	per cent

The carbon content of the tool is proportional to the work that the tool must do and the service demanded of it.

A brief table of the carbon content of various tools is given as this summary will be of aid in selecting the correct bar stock for the job in question:

Track bolt dies (water-cooled), hot worked tools—.45–.55 per cent carbon.

Bolt and rivet headers; hot work generally, hot sets, smith-shop tools, flatters, wedges—.55–.65 per cent carbon.

Track tools; smith-shop tools, rivet sets, copper tools, hot drop forge dies—.65–.75 per cent carbon.

Shear blades, hammers, punches, chisels, forging dies, boiler-makers' tools; track chisels, sledges—.75–.85 per cent carbon.

Punches, large cutting dies, mining drills, hard chisels, shear knives, cold work drop dies—.85–.95 per cent carbon.

Taps, reamers, cups, cones, springs, punches, axes, channelling drills—.95–1.05 per cent carbon.

Milling cutters, reamers, taps, trimming dies, saw swages, circular cutters, threading dies, wood working tools—1.05–1.15 per cent carbon.

Small taps, forming and boring tools, twist drills, screw dies, preening tools, drawing dies, mandrels, razors and edged tools, ball races—1.15–1.25 per cent carbon.

Lathe, planer and slotter tools, drawing dies, brass working tools and very hard tools—1.25–1.35 per cent carbon.

Roll corrugating and chilled roll turning tools—1.35–1.45 per cent carbon.

Roll corrugating and chilled roll turning tools and other tools necessitating extreme hardness—1.45–1.65 per cent carbon.

Alloy steels

By the selection of the proper type of plain carbon steel, practically any tool operation can be performed. However, when increased production is desired by employing faster speeds and feeds, or where greater tool life is an advantage, then alloy steels must be employed.

Plain carbon tool steels are alloyed with the following elements either singly or in combination: Tungsten,

chromium, vanadium, cobalt, nickel, molybdenum and uranium. Some efforts have been made to incorporate cerium, tantalum, and other rare alloys with doubtful or inconclusive results.

Alloy tool steels have further divisions, such as, non-deforming oil hardening tool steel, fast finishing steel and high speed steel.

Oil hardening steel will analyze between:

.85	1.00 per cent	carbon
1.00	1.25 per cent	manganese
.40	.75 per cent	chromium
.40	.50 per cent	tungsten
.15	.25 per cent	vanadium

Some brands of non-deforming oil hardening steels contain chromium only; others are combination of chromium and tungsten and yet others which are composed of chromium, tungsten, and vanadium.

Fast finishing tools or, sometimes called semi-high speed steel, occupies a plane intermediate between plain carbon and high speed steel. Steels of this type will withstand more wear and abrasion than straight carbon steels; again, they impart a very smooth finishing cut to cast iron, steel or brass, and are non-deforming when quenched in oil.

High speed steel tools can be run with the nose of the tool red without appreciably affecting the cutting qualities of the tool, whereas, straight carbon steel at this temperature will lose its hardness and be useless. For example, a high speed tool will have practically the same hardness at 1,100 deg. F. as it will have at room temperature, whereas, a straight carbon steel will have a hardness of practically one-third of that which it has at room temperature.

The majority of high speed steels comply with these limits:

Carbon	.60	.75 per cent
Manganese	.20	.30 per cent
Phosphorus	.025 max.	
Sulphur	.025 max.	
Silicon	.25	.30 per cent
Tungsten	13.00	18.00 per cent
Chromium	2.75	4.50 per cent
Vanadium	.35	1.75 per cent

Some high speed steels also contain 3.00—4.00 per cent or cobalt; 0.30—1.00 per cent molybdenum and .20—.75 per cent uranium. For the maximum performance a tungsten content of 18.00 per cent has been found the best. Above this amount increased brittleness is experienced, whereas, below this amount the cutting and wearing properties of the steel are lessened.

Four per cent of chromium has been found by experience to impart sufficient hardness and render the tungsten more soluble. About .80—1.00 per cent of vanadium has been found to confer the most desirable properties to high speed steel. Molybdenum is approximately two to two and one-half times more effective in high speed steel than tungsten. That is, eight per cent of molybdenum will give the same effect as 18 per cent tungsten more soluble. About .80—1.00 per cent of cause a surface softness and therefore has prevented the use of molybdenum in larger quantities. Uranium does not seem to offer any general advantages and there is always the danger present of contaminating the steel with uranium oxide. This oxide would naturally interrupt the homogeneity of the steel and weaken its structure.

Heat treatment of plain carbon tool steel

As is well known the hardening temperature of steel is proportional to the carbon content in the ranges of .10 per cent—.90 per cent. To harden steel it is necessary to heat it above what is known as its critical temperature. This temperature is the point where the compound formed by the union of carbon and iron or iron carbide dissolves in the remaining iron or ferrite to form a solid solution, known, as, austentite. It is the retention of this solid solution or phases of this solid solution at ordinary temperatures which confers upon the steel its hardness. For best results, tool steel should be normalized before hardening. This places the crystalline structure in the best state to receive the hardening treatment.

Naturally the normalizing temperature varies with the carbon content. Steel running .65 per cent—.80 per cent are heated to 1475—1525 deg. F. whereas, higher carbon content of 1.00—1.25 per cent are normalized at 1575—1675 deg. After complete saturation of the heat the steel is allowed to cool freely in the air. For the normalizing and hardening heats the heating can be done in a lead bath, open furnace, or salt bath. The trend in practically all tool shops is towards the use of special salt baths for the heating operations. Salt baths and lead baths are faster heaters than a dry furnace and the tool is free from scale, whereas, heating in a dry furnace ofttimes results in scaling and also decarbonization or soft spots. Again, dry heat furnaces suffer from lack of uniformity resulting in unevenly heated steel. Easily 50 per cent of the trouble from warping can be laid to unevenly heated steel.

Lead baths are objectionable as they are subjected to more temperature fluctuations than salt baths.

Plain carbon tool steel is hardened at temperature ranging from 1380—1550 deg. F. The higher the carbon the lower is the hardening temperatures. After complete saturation of the heat, the steel is quenched in water at 70 deg. F. Freshly quenched tool steel is in a condition of strain and subject to easy breakage, owing to is brittleness. It should be immediately tempered in oil, any other liquid heating medium or furnace and allowed to cool. If it is only desired to relieve strains, tempering is carried out from 350—375 deg. F. For relieving strains and reducing brittleness, temper from 400 to 500 deg. F. To relieve strains and toughen, heat from 500 to 600 deg. F.

At about 600 deg. F., plain carbon tool steel will rapidly soften with consequent loss of cutting edge and life of tool. In fact, drawing at 600 degrees F., causes an approximate loss of 20 per cent in hardness. This loss in some tools is compensated for by the increase in strength and toughness. In tempering, the heating medium should have the largest heat capacity possible, so as to obtain uniformity of the tempering effects. Special salt baths have been devised for tempering operations above 300—350 deg. F. and they are rapidly replacing oil and dry heat furnaces. Oil is objectionable as it sludges, gives off objectionable fumes, danger of fire and necessitates that the work be cleaned after drawing.

Dry heat furnaces cause oxidation and are of small capacity. The biggest defect of dry heat furnace is temperature non-uniformity. You appreciate a poorly drawn tool is defective, as it contains uneven strains and stresses.

Heat treatment of finishing steel

Dies, taps, and other tools which cannot be ground after the heat-treating operation, should be made of this type of steel. When oil hardening, tool steel should be normalized before hardening. To normalize heat uniformly to 1450 to 1500 deg. F. and hold at this temperature to allow complete penetration of heat and maximum grain refinement. Cool slowly from the normalizing heat in lime, mica, informal earth or any similar medium.

To harden the type of steel, heat to 1450—1500 deg. F. and upon complete penetration of the heat, quench in

a light oil. The steel should be removed from the oil when it has fallen to a temperature of 225 deg. F. The selection of the proper quenching oil is of importance, as the securing of the maximum qualities are greatly dependent upon the quenching medium. The oil should be of such a character that it abstracts the heat from the steel in the most even and uniform manner. This uniform quenching tends to eliminate warpage and the setting up of uneven stresses.

The most satisfactory quenching oil will be an entity, instead of a blend of different oils as each individual oil possesses different characteristics. Again, the oil should be of such a nature that it will not oxidize and sludge nor thicken after constant use. This thickening will alter the quenching speed of the oil and result in non-uniform production. Re-heat immediately after quenching to 325—400 deg. F. in oil or salt bath and hold for one-half hour. Quench from tempering heat in hot water and in oil or air for intricate or small sections.

Heat treatment of fininshing steel

This type of steel should be annealed at temperatures of approximately 1450—1525 deg. F., and allow complete heat saturation. To prevent scaling, this heating can be done in a closed box containing carbonaceous matter or preferably, in suitable salt baths. After normalizing, cool slowly in a salt bath, lime, or similar medium. For hardening, heat to 1475—1525 deg. F. soak for heat penetration, and quench in water. Re-heat immediatey in oil or salt bath at a temperature of 300-500 deg. F. according to use of steel. Remove and quench in water or for small sections in air or oil.

Heat treatment of high speed steel

The correct heat treatment of high speed steel may be divided into six operations, namely: Pre-heating, hardening heating, first quench, second quench, drawing and cooling.

High speed steel is pre-heated usually to 1600 deg. F., so that the hardening heating at 2300—2400 deg. F. can be done rapidly to increase production as well as obviate the necessity of keeping the steel at the high heat for too great a length of time. It is more beneficial for the steel to bring it up to the high heat by two steps, instead of subjecting the cold steel to the sudden high heat.

The pre-heating and heating for hardening should be carefully carried out so as to avoid scaling, uneven heating, which cause checking, due to the uneven expansion of the tool. Again, preheating allows all the elements of the steel to enter into solid solution at the same time and thereby eliminates grain growth with the consequent weakening of the tool.

After complete saturation at the hardening temperature of 2300—2400 deg. F. it was formerly the practice to quench by means of an air blast or into oil. The use of an air blast has been avoided as it oxidized the edges, formed pits and impeded subsequent operations. The air blast was replaced with quenching in oil, but subsequent research showed that quenching high speed steel in two steps resulted in the most satisfactory tool.

The modern practice is to quench from the hardening heat into a salt bath at 1075—1175 deg. F. and hold there until the tool reaches the temperature of the bath. This operation eliminates the tendency to warping and cracking without altering the hardness of the steel. As the quenching and drawing of the high speed steel are two distinct and separate operations, the steel is removed from the bath at 1100 deg. F. and allowed to cool freely in air to below 400 deg. F. and replace immediately in the drawing bath at 1075—1175 deg. F. The steel is held here for a time, ranging from 30 min. to two hours, according to its size. Remove and cool in air or if time is a factor, quench in oil.

It might be argued that the draw back at 1100 deg. F. could be eliminated by holding the tool at 1100 deg. F. in the first quench for a longer time. Experiment has shown that such a tool upon subsequent cooling, will be hardened and not drawn, as the final hardening of high speed steel takes place below 500 deg. F.

Grinding and clearance angles

It is best to dress a tool by turning up one end and nearly at right angles to the shank so that the nose will be high above the body of the tool, and it should leave the smith-shop with a clearance angle of 20 deg. When grinding a tool care should be taken to avoid overheating. A stream of water of low velocity should play upon the nose of the tool so as to dissipate the heat formed at the tool nose.

Allowing the nose to become overheated will have the effect of drawing, with the consequent softening. This softening will cause the tool to become dull early in service, thereby, necessitating regrinding often. When tools are ground by hand they should not be held firmly against the wheel, but should be moved over the surface of the emery wheel.

Automatic tool grinders are economical, even in small shops. These grinding machines should have some means of automatically adjusting the pressure of the tool against the grinding wheel. It can be easily seen that the pressure should be so regulated that the tool will not over heat.

In grinding a tool it should be given more side than back slope as the tool can be ground many times more without weakening it, the chips tend to run off sideways without striking the tool posts and clamps. The pressure of the chip tends to deflect the tool in one direction; therefore, a steep side slope corrects this by bringing the resultant line of pressure within the base of the tool, also the tool is easier to feed.

Drawbars and pins

By D. Hayes

New York, Chicago & St. Louis, Chicago

All drawbars, safety bars and drawbar pins are made from double refined iron in accordance with specifications furnished from the engineering department.

In forging drawbars special care is given to heating the billet to a good wash heat. This ofttimes prevents seams and blisters from showing up at the time the bars are finished, thus avoiding any argument as to the working of the material. All new drawbars are annealed after being forged. Then they are taken to the machine shop, holes drilled, and they are ready for service.

All new drawbars when being forged are made 1/4 in. larger than the blue print measurements. This gives a safety margin on print sizes which prevents the bar from being made undersize should it be drawn to the length required. Referring to the material from inside of hole to end of bar 1/2 of material above print sizes is added. This permits the hole to be repaired from the inside without upsetting, which both shortens and repairs the holes at the same time.

The repairing of drawbars is apparently a set method by upsetting the hole and welding a piece around the end. This we are doing at such times that the hole in the bar is worn at the end below print sizes and does not assure a good safe amount of the original material at the end of the hole.

In repairing drawbar pins if the pins are worn from 1/16 to 1/8 in. we upset at the worn part and round up to the original size. If the pins are worn any more than the size mentioned, it is drawn to the following size of pins used. By using the above methods of making and repairing drawbars and pins, coupled with inspection every 90 days, our failures are too few to mention.

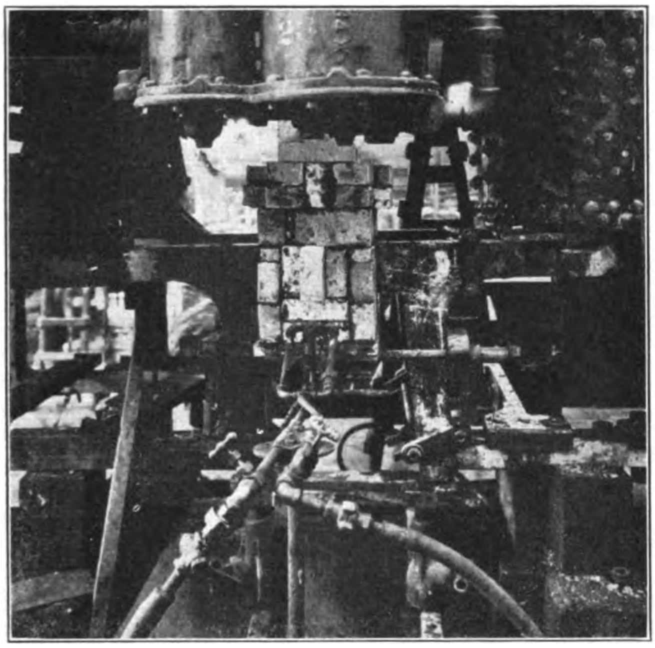
Frame making and repairing

By S. J. Uren

Foreman blacksmith, Southern Pacific, Sacramento, Cal.

Frame making is a thing of the past in the forge shop as the steel foundries have taken up the task of manufacturing cast steel frames, which answers the purpose just as well, at a lower cost per pound than wrought iron frames can be made, and as the locomotives of today are so much heavier than they have been in the past the frames have to be made so much larger that I do not think the foreman blacksmith will have to worry any more about the manufacturing of wrought iron frames.

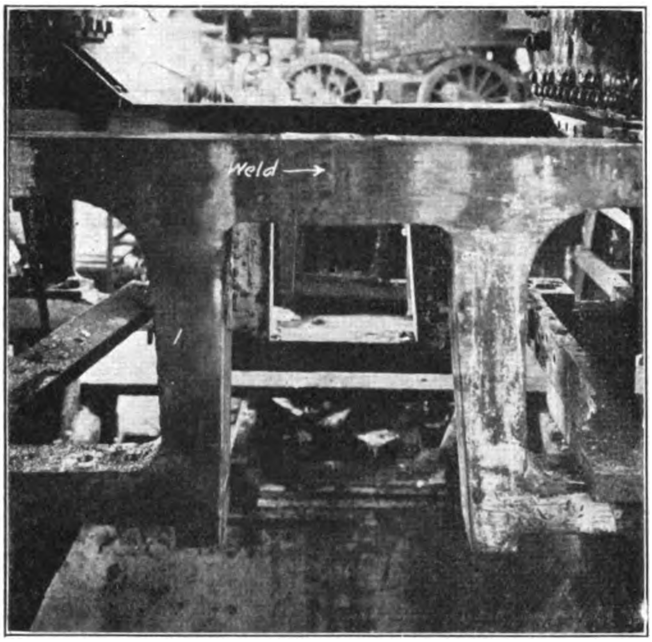
As cast steel frames are being made for most all new equipment, the question arises as to the best method of repairing when these frames break. There are so many different opinions as to the best method for repairing frames that it is a hard matter to decide which is the best. Good results are obtained from the Thermit method of welding, also there are many that use the electric and others the acetylene, and as we all know that the locomotive is supposed to make a certain mileage before it is sent to the main shop for general repairs, if a frame should break before it makes the mileage that is intended of it, the best and quickest method of repairing the break should be used so that it can be kept in service until such time that it has to be sent to the main shop for its general repairs.



This shows the method of applying the furnace and oil burner for preheating the parts

When an engine is sent to the Southern Pacific Sacramento shops for general repairs the frames are thoroughly examined and if any defect shows up in the frames or there are too many Thermit or electric welds in any one section, a new section is cast and the old section is sawed off between the pedestal jaws and scrapped. The new section is machined and placed in position for welding. As I have had more experience in the oil method of welding than any of the other methods, I will explain one of the methods used for the repairing of a large number of frames.

When a frame is cracked or broken close to the corner of the pedestal jaw in the top rail, we saw the frame between the pedestal jaw and about 12 in. back of the pedestal jaw and also near the center of the leg. This old T-piece is removed and a new T-piece placed in position for welding. The first weld is made in the top rail back of the pedestal jaw, the second through the center of the pedestal jaw and the third through the center of the leg, or if the frame is broken near the corner of the pedestal jaw in the lower rail of the frame an L-shaped piece is made and welded to the lower rail of the frame first and then through the center of the leg, or if a new section has to be made the welds are made through the center of the pedestal jaws. We know by making our last weld through the center of the leg or through the center of the pedestal jaw that we are getting the proper expansion and contraction, thereby leaving no strain whatever in the frame.



View of the frame pedestal jaw, showing the completed weld

When preparing for the weld a jack is used, in some instances, between the pedestal jaws for the purpose of spreading the frame and between the top and lower rail of the frame near the pedestal jaw in other instances. The frame is spread to about a one-inch opening, a wrought iron block one inch thick and 1/8 in. larger than the frame section is placed in this opening. Two 1¼-in. truss rods are fastened to the frame when the weld has to be made in the rail of the frame or through the pedestal jaw. When the weld has to be made through the center of the leg a jack is placed underneath the leg. By screwing up the nuts on the truss rods or pumping up the jack when the parts are brought to the proper welding heat presses the parts together.

The furnace used for heating the parts takes about one hour to construct and is so constructed that the flame continually circulates around the parts to be heated and passes out a small opening at the top. Crude oil is used for fuel and is blown through the burner into

the furnace with about 80 lb. air pressure. When the parts have been brought to the proper welding heat and pressed together, a loose brick in the front and back of the furnace is removed and two rams placed in 90 lb. pneumatic air hammers are put through the openings directly on the welded section and the weld smoothed over. A sudden jerk on an iron rod which helps hold the furnace in position drops the furnace into the pit. Chisels are then placed in the air hammers and the surplus stock that forms on the under side and top rail or the inside of the leg, as the case may, is cut off.

This method of repairing frames at the Sacramento shops has been in practice for some time with good results and very few failures, and the parts welded brought to as near the original size of the frame as possible, leaving no strain whatever in the frame and also leaving the frame within 1/32 in. of the original length. Three-sixteenths of an inch to 5/16 in. is allowed for shrinkage according to the size frame to be heated.

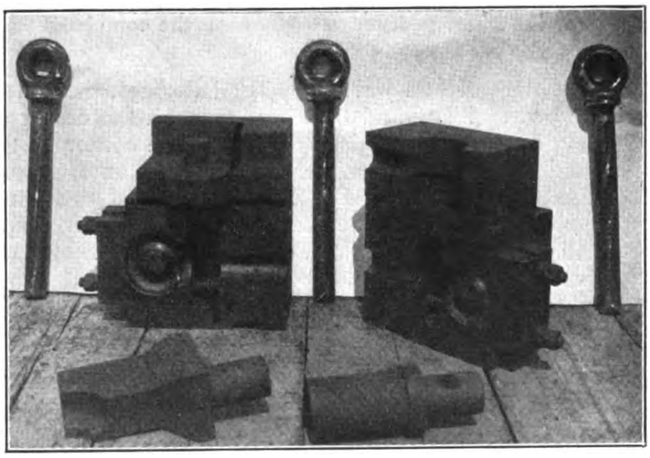
Tools and formers

By J. M. Bradley

Blacksmith foreman, Texas & New Orleans, Houston, Tex.

In our shop in Houston we have quite a number of forging machines, bulldozers, hydraulic forging presses and spring making and repairing machines. Practically all of our car and locomotive forgings that can be, are made on these machines. We do not have any trouble getting formers and dies made, all we have to do is to show that it will pay and we get them. All formers on our bulldozers are made of cast iron and very seldom require machining and so the cost is not high.

Practically every year we have a program to build cars or locomotives and sometimes marine boilers and when I get the drawings and find out just what I can build on

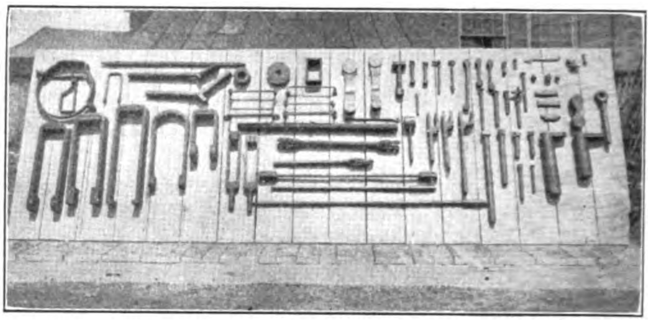


Dies used on forging machine for making eye-bolts

the machines, I submit to the drafting department sketches of the forgings that I wish to make.

One illustration shows an eye bolt made on a 3-in. forging machine out of 1¾-in. round bar stock. The rod is heated, placed on top of the die and bent in the shape of an eye bolt, then placed back in furnace and brought to a welding heat and placed in the bottom step and welded; this makes a first class forging with very little flash except in the eye. We have several size eye bolts made in this way.

Swinging hangers for four wheel truck steel coaches are also made by machine. This hanger was formerly made of 1-in by 4-in. flat iron, one side off-set to form the jaw, but our company adopted open-hearth steel for iron so we are now making them by forging on our hydraulic forging press and finishing in the machines. This is an excellent job as this hanger is drilled and applied and runs until the car is shopped again, when it



Display board showing forgings made by machine at the Houston, Tex., shops of the T. & N. O.

is rebored and bushed and is ready for service again. Another illustration shows a display board of forgings which are made on machines.

Spring making and repairing

By J. B. Ray

Blacksmith foreman, Missouri Pacific, N. Little Rock, Ark.

The first consideration in making springs should be quality. Without quality, regardless of methods and practices, you will fail. Quality is obtainable only by using a grade of steel suitable for this special purpose and good workmanship in handling and above all the correct method of heat treatment when the proper grade of steel has been furnished. Then it is strictly up to the forge shop foreman to see and know that good workmanship and proper heat treatment is applied. The old slip-shod method of heating plates for setting must be abandoned and furnaces must be so constructed that the fire will not impinge on the steel. Temperatures above 1675 deg. F. should not be permitted for the purpose of setting plates to the desired radius. When plates are set they should be laid aside and allowed to cool, then recharged into the furnace and heated to 1475 deg. F. quenched in a suitable quenching medium, then go into the drawback. They should remain in the drawback at a temperature of approximately 760 deg. F. for from 15 to 45 min. dependent upon the size of the steel.

I have purposely omitted saying anything about the various operations necessary—such as cutting, punching and nibbing, all of which is essential in spring making. But the facilities furnished for doing this work vary so greatly in railroad shops that it is incumbent upon the forge shop foreman to do the best he can with equipment at his command. It is a question whether or not it is economical to strip the springs from the band or cut the bands off and consign them to the scrap pile. I believe it to be the better plan to cut them off and make and apply new bands. All bands should be applied by hydraulic pressure. Another mistake usually made is to cool the bands in water after pressing them on. This should not be permitted. Each and every spring should be thoroughly tested after the band is on.

As to making new bands. There are, to my knowledge, only two ways of forging bands economically in large quantities; one is to bend them on a bulldozer or forging machine and weld them in the forging machine, or roll them out into a U-shape on the bulldozer and weld under a suitable type of power hammer. Both practices are good and the costs are practically the same.

General foremen's program is well balanced

Subjects of interest to both car and locomotive men will be presented at annual meeting

THE annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, September 7 to 10, inclusive. It is not difficult to get enthusiastic about the program of the meeting which has been designed to exclude matters of more or less secondary importance and promote discussions of at least a few of the many important and difficult problems which confront railway general foremen in the work of the car and locomotive departments.

The opening address will be a discussion of "The Possibilities of the General Foremen's Association" by E. L. Woodward, western editor of the *Railway Mechanical Engineer,* followed by President Warner's address and the report of the secretary-treasurer. At subsequent sessions, the convention will be addressed by such men as C. L. Dickert, superintendent of motive power, Central of Georgia; D. C. Curtis, chief purchasing officer, Chicago, Milwaukee & St. Paul; F. H. Becherer, superintendent car department, Central Railroad of New Jersey; and M. A. Hall, superintendent of machinery, Kansas City Southern. These officers, all of whom are well known in the railway mechanical world, will speak on selected topics and no general foreman who finds it at all possible to get away from the regular routine of his daily task can afford to miss hearing them.

The program, a detailed report of which follows, is in many respects the most interesting and valuable in possibilities of good for the railway service that has ever been provided by the International Railway General Foremen's Association. Help the good work which this association is doing by attendance at the convention and active participation.

H. E. Warner (N. Y. C.)
President

C. A. Barnes (C. & N. W.)
1st Vice-Pres.

F. M. A'Hearn (B. & L. E.)
2nd Vice-Pres.

W. F. Hall (C. & N. W.)
Secretary

The convention program

Tuesday, September 7

9:30 a. m.

Address of welcome by Mayor Dever.
Response by Pres. H. E. Warner.
Address, "The possibilities of the General Foremen's Association," by E. L. Woodward, western editor, *Railway Mechanical Engineer.*
Response, J. N. Chapman.
President Warner's address.
Report of secretary-treasurer.
Appointment of committees.

2 p. m.

Topic No. 1—Balancing shop sub-departments.
Locomotive department, E. F. McCarthy, chairman.
Car department, A. H. Keys, chairman.
Discussion.

Wednesday, September 8; 9 a. m.

Address by L. C. Dickert, superintendent motive power, C. of G.
Response, A. H. Keys.
Response, T. C. Gray, supervisor of apprentices, Missouri-Kansas-Texas.
Topic No. 2—Development of the mechanic, R. J. Farrington, chairman.
Discussion.

2 p. m.

Topic No. 3—Maintenance of refrigerator car, J. N. Chapman, chairman.
Discussion.
Election of officers.

Thursday, September 9; 9 a. m.

Address by D. C. Curtis, chief purchasing officer, Chicago, Milwaukee & St. Paul.
Response, F. M. A'Hearn.
Topic No. 4—The general foremen's responsibility for material surplus or shortage, F. M. A'Hearn, chairman.
Discussion.

2 p. m.

Address by F. H. Becherer, superintendent of car department, C. R. of N. J.
Response, W. F. Lauer.
Topic No. 5—Developing railroad shop foreman, J. R. Leveridge, chairman.
Discussion.

Friday, September 10; 9 a. m.

Address by M. A. Hall, superintendent machinery, K. C. S.
Response, F. B. Harmon.
Topic No. 6—Modern shop equipment as a factor in increased production, H. W. Harter, chairman.
Discussion.
Reports of committees.
Unfinished business.
New business.
Adjournment.

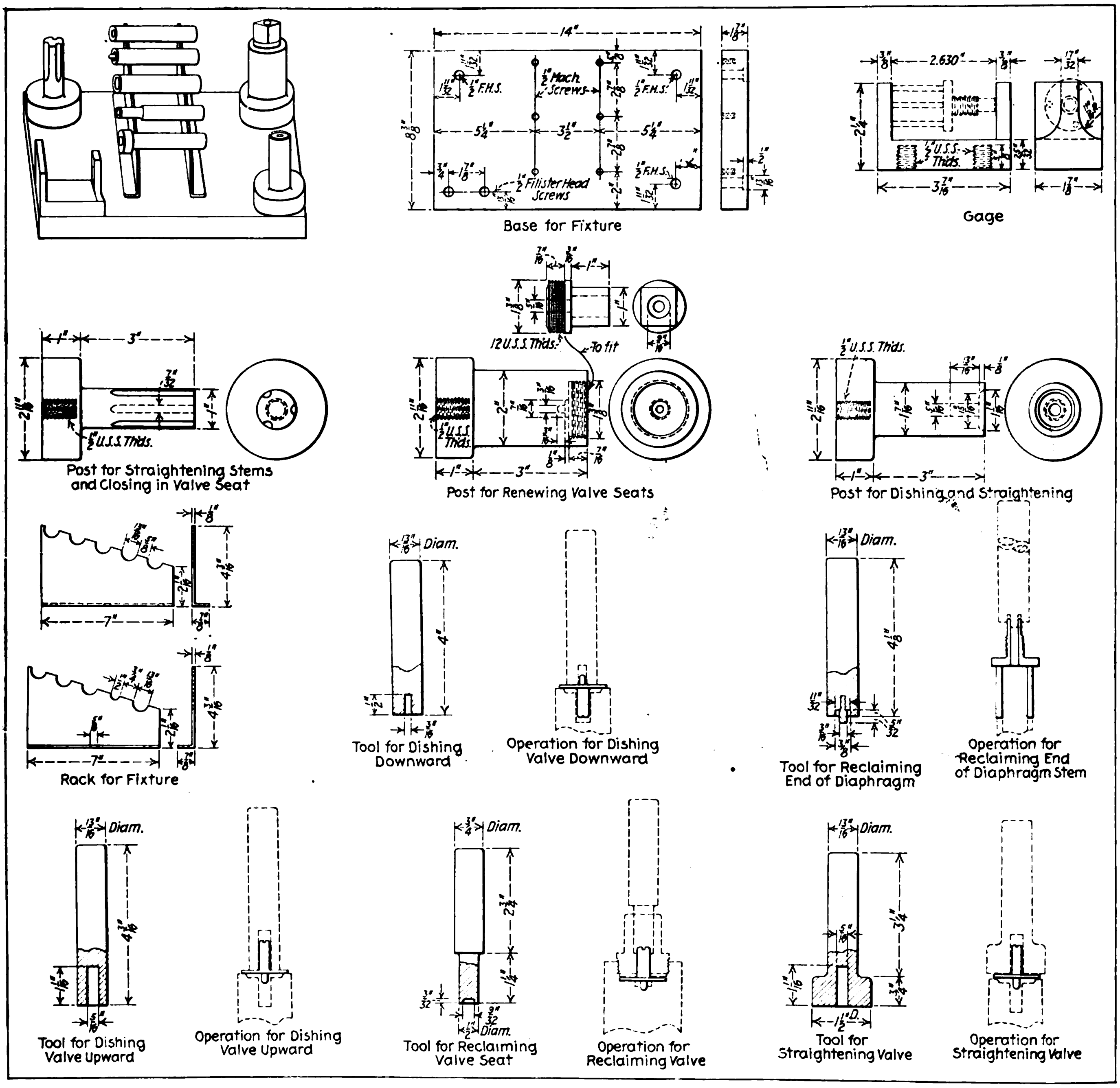
Tools for reclaiming signal valves

The fixture and tools, shown in the drawing, are used in reclaiming the BA signal valves of the New York Air Brake Company. Referring to the drawing, the fixture for holding the assembled tools is shown in the upper left-hand corner. The base for the fixture is shown at the right and the rack for holding five of the round tools is shown at the left in the second row from the bottom of the drawing.

Beginning with the tool shown in the top row at the upper right-hand corner; this tool is used as a gage for the diaphragm stem, known as part SV25. The tool at the left in the third row from the bottom is a post for straightening the stems and closing in the valve seat of the diaphragm. The next tool in the same row is a post for renewing the valve seat on the valve, known as part SV8. The last tool in the third row is a post for dishing and straightening part SV8.

The two drawings in the center of the second row from the bottom show the tool for dishing the valve, part SV8 downward, and how the tool is used for this job. The last two drawings show the tool for reclaiming the end of the diaphragm, part SV25, and the method of using the tool.

In the bottom row, three tools are shown, the first of which is a tool for dishing the valve, SV8, upward in the manner shown in the drawing at the right of the tool. The tool in the center is used for reclaiming the valve seat, part SV8, and the method used is shown at the right. The last tool, shown at the lower right, is used for straightening the valve, SV8, for which the method of operation is also shown. Providing a rack for the tools makes it easier to find them when wanted.



Drawing of fixture and tools used in reclaiming BA signal valves

Tool foremen have interesting program

Reports to be presented on new labor-saving tools, training of men, and standardization

THE program arranged for the fourteenth annual convention of the American Railway Tool Foremen's Association to be held at the Hotel Sherman, Chicago, September 1, 2 and 3, covers practically every important phase of tool room work and administration. Tool foremen and others interested in the general subject of the railroad shop tool room who attend the convention this year will find considerable in the way of helpful information and practical ideas that they can profitably take back home with them. Six reports of standing committees on the subjects of new labor-saving tools and devices for the air brake department, training of men suitable for toolroom work, standardization of present special boiler taps, new tools and safety devices for the car department, general locomotive shop kinks and devices, and standardization will be presented. The report on "Training men suitable for toolroom work" is a new subject on the convention program of the association. Training men is an important part of the toolroom foremen's job and the report and subsequent discussion should be interesting.

L. A. Richardson, general superintendent of motive power, Chicago, Rock Island & Pacific, is scheduled to make the opening address which will be followed by the address of President E. A. Hildebrandt, machine shop foreman and formerly tool foreman of the Big Four at Beech Grove shops, Indiana. At the morning session on the second day of the convention, Edwin W. Ely, assistant director, Department of Commerce, will address the association on "Simplification, a new tool for the tool foreman." Mr. Ely, being associated with Secretary Hoover in the campaign to prevent waste in industry will, in all probability, have a number of excellent suggestions as to how the toolroom foreman can prevent waste in the work of his department.

Following is a detailed report of the program. Abstracts of the various reports and addresses together with a report of the more important business transacted during the convention will be published in subsequent issues.


E. A. Hildebrandt (Big Four)
President


O. D. Kinsey (C. M. & St. P.)
1st Vice-President


E. A. Greame (D. L. & W.)
2nd Vice-President


G. G. Macina (C. M. & St. P.)
Secretary

WEDNESDAY, SEPTEMBER 1

9:30 a. m. (Daylight Saving Time)

Address by L. A. Richardson, general superintendent of motive power, Chicago, Rock Island & Pacific.
Address by President E. A. Hildebrandt.
Report of secretary-treasurer.
Appointment of committees.
Unfinished business.
New business.

2 p. m.

Report of Standing Committee on New Labor-Saving Tools and Devices for the Air Brake Department, H. Otto, chairman.
Report of Standing Committee on Training of Men Suitable for Toolroom Work, J. J. Sheehan, chairman.

THURSDAY, SEPTEMBER 2

9:30 a. m.

Address, "Simplification, a New Tool for the Tool Foreman," by Edwin W. Ely, assistant director, Department of Commerce.
Report of Standing Committee on Standardization of Present Special Boiler Taps, O. D. Kinsey, chairman.
Report of Standing Committee on New Tools and Safety Devices for the Car Department, G. Reichart, chairman.
Election of officers.
Special visit to exhibits.

FRIDAY, SEPTEMBER 3

9:30 a. m.

Report of Standing Committee on General Locomotive Shop Kinks and Devices, J. E. Carroll, chairman.
Report of Standardization Committee, E. J. McKernan, chairman.
Report of Committee on Auditing, Committee on Thanks, and other special committees.
Selection of place for annual convention.
Adjournment.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

One method of casehardening a valve motion link

LOWELL, MASS.

TO THE EDITOR:

On page 305 of the May issue of the *Railway Mechanical Engineer,* Mr. McCabe asks for information pertaining to the casehardening of Walschaert valve gear links. It is our practice to take these links after they have been machined, and put them in a casehardening pot sufficiently large to pack the link. Houghton's Pearlite compound is used, putting a layer of Pearlite about 4 in. deep on the bottom of the pot and then placing the link on its edge in the pot, packing about 3 in. or 4 in. of Pearlite around the link. The pot is then placed in the furnace and held at a temperature of 1,700 deg. F. for eight hours, after which it is taken out and quenched in a large tank of Houghton's No. 2 quenching oil. The link is left in the quench until cold, after which it is annealed around the cheek plate and radius bar holes with an acetylene torch to relieve the strain at these points.

We have been using this method for about 1½ years and have had no links warp or get out of shape.

W. J. WIGGIN,
Blacksmith foreman

Is this the solution to the hot box problem?

HAMMOND, Ind.

TO THE EDITOR:

A popular subject for discussion among various railroad clubs at the present time and a favorite subject in the years gone by is our old pal the "hot box." The lubricating engineer of the A. B. C. railway reads a paper before the Podunk Carmen's Club. The paper is a good one and is thoroughly discussed. The author of the paper is given a rising vote of thanks and the members of the Podunk club "gird their loins" and go forth to do battle with their common enemy.

The expert in charge of lubrication on the X. Y. Z. railroad prepares and reads a paper before the Big Town Railway Club; subject, "Hot boxes, their prevention and cure." He is given a vote of thanks, etc. Some of the papers are really well prepared and probably are understood by most of the club members. Others are technical; oh, very technical indeed! It is doubtful sometimes if an occasional paper is understood even by the gentleman who prepared it.

In their efforts to find a method of overcoming the friction between the journal and bearing, so many gages to measure the bearings, keys, journals, boxes and dust guards have been designed that the journal box attendant would need considerable assistance if he tried to use them all. One expert says don't do this; another says don't to that. And after all is said and done they are only hoping for a reduction in delays caused by hot boxes. But to paraphrase the song "The little hot box on the railroad keeps burning the mileage away."

For many years no change has been made in the method used in affording lubrication to car journals. In a comparatively short time the capacity of the car has been doubled. The cry for speed and more speed is increasing. The more weight and speed means more friction, which in turn spells more freight car hot boxes.

This may be treason, but the writer wonders if the time isn't near when the old brass and packing method of the present will not have to give way to the modern roller bearings.

The initial cost would be high, but after reviewing the results in the motor industry, it might finally be the cheapest.

H. R. RICE.

The consequences of valve motion failures

TOPEKA, Kan.

TO THE EDITOR:

I read in the August issue of the *Railway Mechanical Engineer* a letter in reply to C. M. Lee by W. T. Speak, regarding a broken union link pin on a Walschaert valve gear, which caused breakage of the cylinder casting, in which the latter asks for opinions as to the correctness of his statement.

I believe Mr. Speak is correct. The union link not only transmits the movement of the crosshead to the combination lever and, thence to the valve, but it acts as a support for the reaction from the movement of the valve by the radius rod, which is transmitted from the eccentric rod, through the link to the radius rod. The radius rod connection at the link block serves the same purpose for the movement of the valve derived from the crosshead through the union link and the combination lever. Without the reaction of both of these points, the valve does not move. The failure of any part or connection between the link block and the motion plate on the crosshead, causes a like consequence.

Should the valve stop on center with the ports closed, all rings being in good condition, the high compression developed with the engine running at high speed would have a tendency to break the cylinder casting, blow out a cylinder head or cause a disastrous failure at a weak point. The chances are that the valve would not stop in such a position once out of a hundred times, but it seems possible that should it stop as stated, the results could be as stated.

The careful inspection of these parts should be impressed upon all inspectors and foremen and the costly results of failure explained.

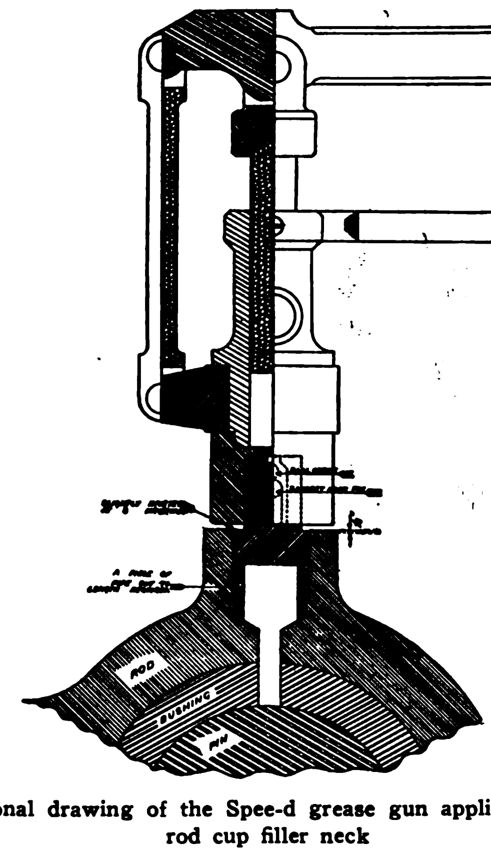
JOHN E. MCGAFFIN,
Machinist gang foreman, A. T. & S. F.

High pressure grease gun

THE device shown in the illustration and known as the Spee-d high pressure grease gun has been used quite successfully for lubricating connecting rod bearings on the locomotives of a southern railroad for nearly four years. This grease gun, a half-section of which is shown in the drawing, is being marketed by the Reliance Machine & Stamping Works, Inc., 900 Tchoupitoulas street, New Orleans, La.

Lubricating a side rod bearing with the Spee-d high pressure grease gun

It consists essentially of a tool steel base which fits over the Spee-d rod cup filler neck, a piston for forcing grease into the bearing and a handle for operating the piston. Screwed into the top of the base is the piston casing in the side of which is a large hole through which the grease stick is inserted. A short handle is secured to the top flange of the piston casing, as shown in the drawing, for the convenience of the operator when applying or removing the grease gun from the rod cup filler neck. The piston is pivoted to the operating handle which in turn is fulcrumed to a collar. The collar fits around the bottom of the piston casing and can be turned freely in either direction with the piston operating



Sectional drawing of the Spee-d grease gun applied to the rod cup filler neck

handle. This permits flexibility in operation, especially if the grease gun must be operated between a side rod and driving wheel, where the clearances are close.

The gun is held in place on the rod cup filler neck, as shown in the drawing, by means of a bayonet lock pin. In fitting up a locomotive for the use of this device, Spee-d rod cup filler necks are installed on all bearings in place of the ordinary grease plugs. In so doing a short piece of pipe cut to the required length is inserted in the grease cup and the rod cup filler neck is then screwed down tight against the top of the pipe and riveted or welded in place.

A bearing is lubricated by the operator securing the gun in position on the rod cup filler neck and inserting a formed stick of pin grease through the hole in the side of the piston casing, the end of the piston being raised above the hole. The piston is then brought down and the pin grease inside the hole is cut off and forced down to the bottom of the piston casing, this operation being repeated until the piston casing is filled up to the hole. The operator then forces the grease down into the bearing by means of an extension lever which fits on to the piston operating handle. The grease is prevented from escaping by the ball check in the rod cup filler neck, shown in the drawing.

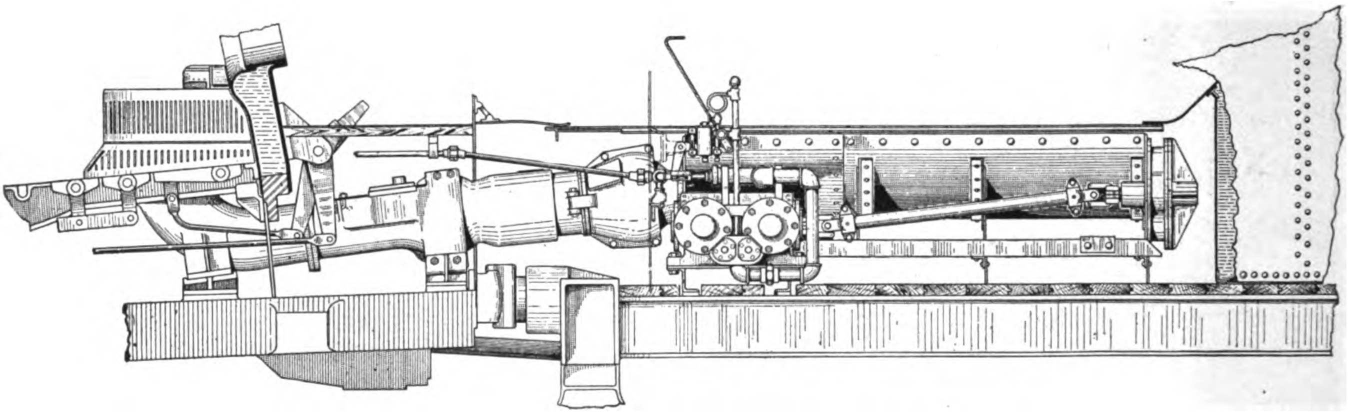
The use of Spee-d rod cup filler necks in conjunction with the Spee-d high-pressure grease gun, enables the applying of a pressure of 4,500 lb. per sq. in., if necessary to force grease having a hard consistency to parts of the bearing requiring lubrication that cannot be lubricated properly and efficiently by ordinary methods. It is claimed that the labor time for filling rod cups can be cut from 32 minutes to 5 minutes per locomotive with the use of this device.

Standard stoker engine placed on the tender

In 1924 the Northern Pacific uncovered what is probably the greatest lignite coal deposit in the United States, if not in the world. Believing that this fuel could be burned to advantage, and economically as compared with other fuels (oil, sub-bituminous and bituminous coal) then in use, the Northern Pacific began making some experiments, the results of which were so satisfactory, that they immediately began making preparations to use this fuel on an extensive scale. Owing to its comparatively low B.t.u. value, however, it was found advisable to equip all road locomotives with mechanical stokers.

Among other locomotives to be so equipped were a number of the Pacific type, on which the actual load carried by the trailer axle was already practically up to the permissible limit (64,500 lb.), which made it necessary to reduce the weight of that part of the mechanical stoker carried on the locomotive to the lowest possible minimum.

Inasmuch as the duPont-Simplex type B stoker consists of two separate units, viz., the stoker driving engine and the conveying system, and as these units are not integral, thus permitting an optional location of the stoker engine with reference to the conveying mechanism, the mechanical engineer of the Northern Pacific suggested transferring the stoker drive engine to the left front corner of the tender. In collaboration with the Standard Stoker Company, Inc., the road worked out an application which was tried in service.



Stoker driving engine located at the left front corner of the tender—Weight removed from the locomotive, 1,709 lb.

Comparing the standard application having the stoker engine located on the rear of the locomotive, with the application illustrated, showing the stoker engine located on the tender, it will be seen that the transfer of the stoker engine not only solved the weight problem, but further simplified the stoker in that it eliminated the universal drive shaft between the locomotive and tender, which consisted of two universal joints and the driving and driven telescoping members. The total reduction in weight carried on the locomotive is the weight of the stoker engine and its supporting bracket, the reversing valve and piping, the stoker exhaust pipe leading from the stoker engine to the front end, and approximately one-half the weight of the universal drive shaft. Aside from the stoker engine, which weighs complete, 1,320 lb., the other weights are variable, depending on the type of locomotive, size of supporting bracket, length of exhaust pipe, etc. Generally speaking, the total weight removed from the locomotive is said to be approximately 1,974 lb.

In transferring the stoker engine to the tender, the supporting bracket is eliminated as the stoker engine is supported on angle irons attached to the tender frame sill. Thus, the weight added to the tender equals the weight of the stoker engine, the reversing valve and piping, the short section of stoker exhaust pipe, and the two supporting angle irons, or a total of approximately 1,355 lb.

In the ordinary water bottom type of rectangular

tender cistern, approximately 165 gallons, or 1,375 lb. of water is displaced by the stoker engine, thereby leaving a perfectly balanced condition on the front tender truck.

The exhaust steam from the stoker engine is discharged into the cistern. The discharge end of the pipe is about two-thirds of the way down so as to avoid heating the water when it becomes low, beyond the lifting capacity of the injector. While the temperature of the feed water is raised by the heat in the exhaust steam, usually about 13 deg., at no time is the temperature increased to such a point that the injector will not handle it. The weight of the steam discharged into the tender varies with the amount of coal delivered, and is equal to 166 lb. for 2,800 lb. of coal, to a maximum of 370 lb. when delivering 16,000 lb. of coal. Thus, the stoker engine returns to the tender in the form of exhaust steam, from 20 to 40 gal. of water per hour, restoring the water sacrificed in making room for the stoker engine.

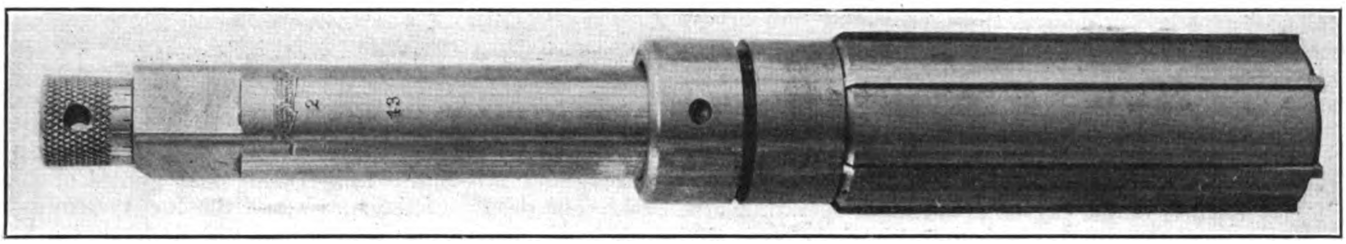
The stoker engine is lubricated from a tap in the main lubricator in the cab just the same as with the standard application. No difficulty has been experienced in obtaining perfect lubrication. When the stoker engine is at rest any condensation that may be obtained in the stoker engine steam pipe, which consists of a flexible pipe having three universal joints, is taken care of by means of an automatic drain cock located at the lowest point of the piping system. Similar provision is made to take care of the condensation that may occur in the stoker engine exhaust pipe. Any possible syphoning action in the exhaust pipe is taken care of by a suitable vent.

While an auxiliary lubricator is shown in the illustration, this was applied only during the first application, but has since been found to be unnecessary.

The stoker engine in this location is more accessible than when located under the locomotive deck. It also leaves that part of the deck, usually occupied by the stoker drive mechanism, free for the application of any other auxiliary devices, such as shaker rigging, train control, etc.

Adjustable expanding hand reamer

THE blades of the adjustable hand reamer manufactured by the Foster-Johnson Reamer Company, Elkhart, Ind., expand parallel and may be expended when inserted for their full length into the work. The adjustments of the blades are effected through the medium of the knurled nut located at the top end of the reamer. The bottom part of the nut is turned and graduated to read the amount of expansion or contraction in thousandths of an inch. The removal of the reamer from the work is effected through contracting the blades and lifting them straight out of the work with little effort.



The Foster-Johnson hand reamer, the blades of which may be expanded while the reamer is inserted in the work

The blades of the reamer, when expanded in the work do not enter the metal, but are only firmly seated against the walls of the hole until revolved. During the first quarter revolution the blades will feed out to the full depth of the cut to which they are adjusted by the knurled adjusting nut. This is accomplished by the spring collar.

These reamers are built in five sizes, from 1⅜ in. to 4¾ in., and the range of expansion varies from ⅛ in. on the 1⅜-in. reamer to ¼ in. on the 4¾-in. size.

Fully enclosed Diesel engine for locomotives

PARALLELING the development work that is being carried on in the design and construction of large Diesel engines for passenger and freight locomotives, the Foos Gas Engine Company, Springfield, Ohio, is now building industrial Diesel engines with from two to eight cylinders, a power range of from 45 to 475 hp. and an operating speed range of from 400 to 900 r.p.m. The smaller units are designed primarily for cranes and shovels and the larger for rail cars and small locomotives.

It is anticipated by the builders that the application of these Diesel units to rail cars and small locomotives will materially reduce the operating cost per mile as compared with gasoline engine operating cost. The new Diesel engine, with its inherent fuel economy, and increased dependability over gasoline engines, on account of more substantial engine construction, slower speed, and more favorable operating characteristics, will, it is anticipated, make possible a further reduction in fuel mileage cost.

An exterior inspection of this unit does not identify it as a Diesel engine as it is entirely enclosed and no moving part is visible. This has been done to provide a power unit for cranes and shovels. To operate successfully in such equipment any engine should be completely protected from dust and dirt and any foreign matter that might get into the bearings and other working parts. The complete enclosure of the engine also saves it from the danger of having tools or other heavy objects fall into the working parts and confines the lubricating oil that is circulated through the engine. The

new unit is designed so that the lubricant can not leak from any part.

While completely enclosed, the new engine is not inaccessible. Large cover plates are provided on both sides, opposite the crank throws, which give access to the lower part of the main cylinder frame. The top of the engine is provided with cover plates that may be lifted up for inspection of the heads, the valves and the valve mechanism.

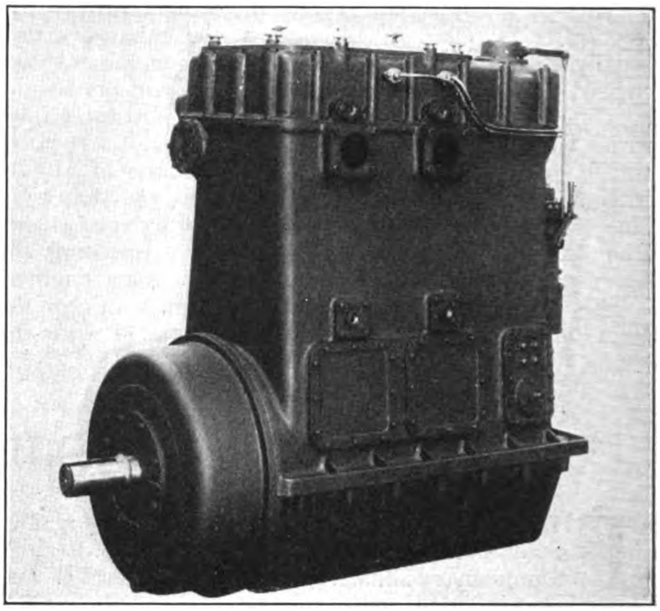
The Foos industrial Diesel is a four-cycle engine and operates on the full-Diesel combustion cycle. A cross section of the engine indicates a plain Diesel combustion chamber; in other words, the head and piston top are flt, there being no recesses or pre-combustion cups of any type. Fuel for combustion is injected into the combustion chamber vertically at the axis of the cylinder. Atomization of the fuel is secured by the mechanical injection principle.

The designers have given considerable attention to the matter of valves and valve gear. Four valves are provided in each head, two for the exhaust and two for the inlet. At the height of the head of the main box frame, which houses the entire unit, a recess in the casting provides the air inlet manifold, and the air inlet valves are located in the head adjacent to the front side of the engine. A passage through the main box frame at the back of the engine is provided for the exhaust gases to enter an exhaust header. For valve operation a camshaft runs the full length of the engine at the height of the cylinder heads. The cam shaft drive involves the use of a silent chain driven directly from the crank shaft.

The moving power plant, as the prime mover of the rail car may be considered, must be simple and accessible. This unit is arranged so that any of the valves or the valve levers may be removed without disturbing any other portion of the mechanism. Throughout the engine, means have been provided that any minor adjustment may be made without difficulty, and without the removal of any heavy engine parts.

The flywheel of the engine is enclosed, operating in a bell housing. All of the fuel pumps and the governor are completely housed, giving them the same protection as is offered the other main working parts of the engine.

A central lubricating oil system furnishes oil to every bearing in the engine under pressure. In the lower part of the bed plates a trough is provided where the lubricating oil is collected. An oil pump picks up the lubricant, puts it under pressure and distributes it to all the bearings of the engine. No oil or grease cups are used.

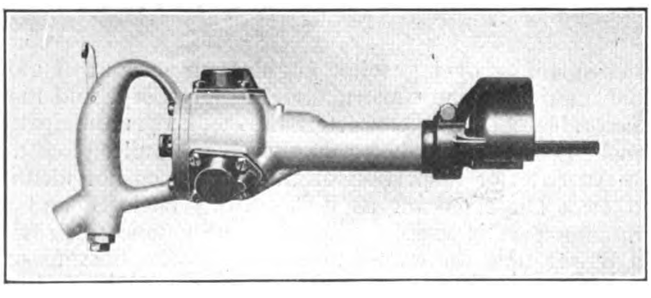


The Foos type L 66 hp. Diesel engine

The Foos Industrial-Diesel has an operating speed from 400 to 900 r.p.m. Tests that have been made at the factory indicate complete combustion is secured throughout this entire range using low grades of fuel oil. The design of the sprays and the fuel system as a whole is such as permits the use of oils having a low gravity.

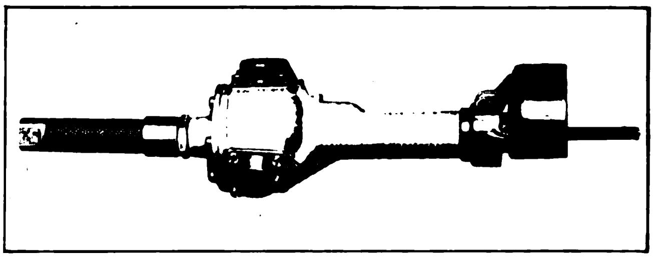
Small pneumatic grinders

A SMALL size of pneumatic grinder has been placed on the market by Ingersoll-Rand Company, 11 Broadway, New York. This size meets the demand for smaller, lighter, higher speed grinders for light grinding work, polishing and buffing. The new size is available in two styles. The No. 61 style has a pistol grip outside trigger handle while the No. 62 has a rolling type throttle handle. The motor used is of the same design which has been used in the larger sizes of Ingersoll-Rand grinders.



The No. 61 style pneumatic grinder fitted with the pistol grip outside trigger handle

The motor has three cylinders spaced about the center line of the spindle and all delivering power to one crank pin. A tool steel crank pin sleeve that is easily and cheaply renewed, fits tightly over and removes all wear from the crank pins. Vibration is entirely eliminated and a steady torque is transmitted to the spindle even when the tool is throttled to a very slow speed.



The No. 62 style pneumatic grinder fitted with a rolling type throttle handle

The entire working mechanism of the motor may be opened up for inspection by simply removing six cap screws and lifting off the handle. All parts of the motor are then accessible. Each of the three cylinders of the motor is a part separate from the body of the machine and may readily be removed if desired. All three cylinders are interchangeable and renewable.

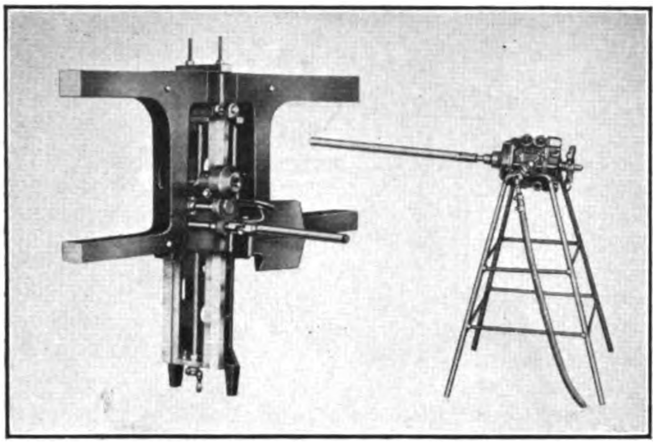
The motor operates in a bath of lubricant so that all the moving parts are constantly immersed. Both the motor and the wheel end of the grinder are entirely enclosed to keep dust and dirt from the working parts.

The following are some of the principal dimensions of the grinders:

Size	61	62
Free speed r. p. m.	6,000	6,000
Weight, pounds (with wheel guard)	8½	9½
Length overall, inches	18½	21¼
Diameter wheel end of spindle, inches	½	½
Maximum width wheel will take, inches	2	2
Distance from side to center of spindle, inches	2	3
Size hose recommended, inches	½	½

Micro portable locomotive frame jaw miller

The Micro Machine Company, Bettendorf, Iowa, has developed a frame jaw miller, intended for milling the plane surfaces against which the locomotive shoes and wedges bear. This machine takes the place of filing, shipping, and hand-grinding methods, and produces a maximum bearing surface in a minimum time. It has a maximum milling length of 33 in. and a width of 7 in. It mills the full length of the jaw and finishes the top radius complete.



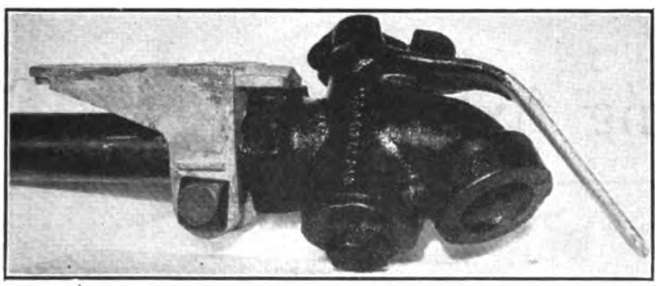
A machine for milling frame jaws up to 7 in. wide by 33 in. long

The sliding cutter head actuates on a heavily ribbed main frame which is 11½ in. wide by 40 in long. A take-up gib is provided for wear. The spiral cutter which is provided with locking screws, is held in bearings of an eccentric design for increasing the depth of cut. The bearings are kept in line by means of a double-pinion shaft, which is also used for increasing the eccentric throw. This shaft is actuated with a wrench from the operator's side. The vertical feed of the cutter head is accomplished by means of a threaded worm gear, driven from an intermediate gear through a shaft and worm, which revolves on a stationary screw. A handle for lowering the cutter head is provided at the bottom.

The mounting is accomplished by drawing the machine tight against the horizontal top section of the frame jaw with a clamp. The lower portion is supported with an adjustable alining bracket and screw placed between the rear side of main frame and the opposite jaw face. The machine is driven through a universal shaft 6 ft. long, by a 300 r. p. m. air motor, mounted on a stand, as shown in the accompanying illustration.

Pipe clamp and angle cock holder

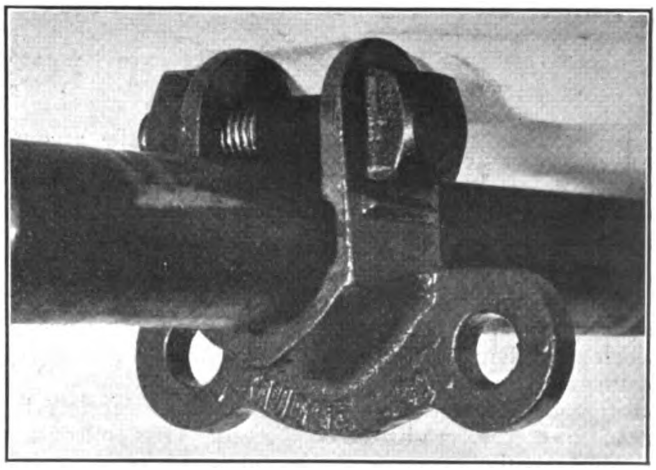
Mudge & Company, Railway Exchange building, Chicago, has placed on the market a pipe clamp and an angle cock holder designed to hold effectively these parts in their proper position. They are made of forged steel and designed to fit old cars. The angle cock holder can be used with any shape of steel bracket which the construction of the car requires. No special keys or forgings are required, as an ordinary bolt effects the clamping.



Angle cock holder designed to be used with any shape of steel bracket

Ample bearing surface on the bolts and clamps insures positive anchorage of the brake pipe and prevents vibration and longitudinal movement. The projecting lip on the angle cock holder fits over the "hex" on the angle cock, and prevents the latter from turning or becoming distorted.

The holes in the clamp, through which the bolt passes,



The Mudge forged steel pipe clamp

are elongated, so as to allow necessary movement of the bolt in the clamp. When the bolt is tightened up the two legs of the clamp are drawn in and, as this action takes place, the bolt is forced up against the pipe. A few turns of the nut cause the bolt to "bite" into the pipe, thereby effectively clamping the latter in position.

The bolt is practically self locking, because of the lug provided on one of the clamp legs and the angularity of the clamp legs when in the clamping position. Double nuts or lock nuts are not essential unless the standard practice of the railroad requires their use under all conditions.

Bullard driving box borer and facer

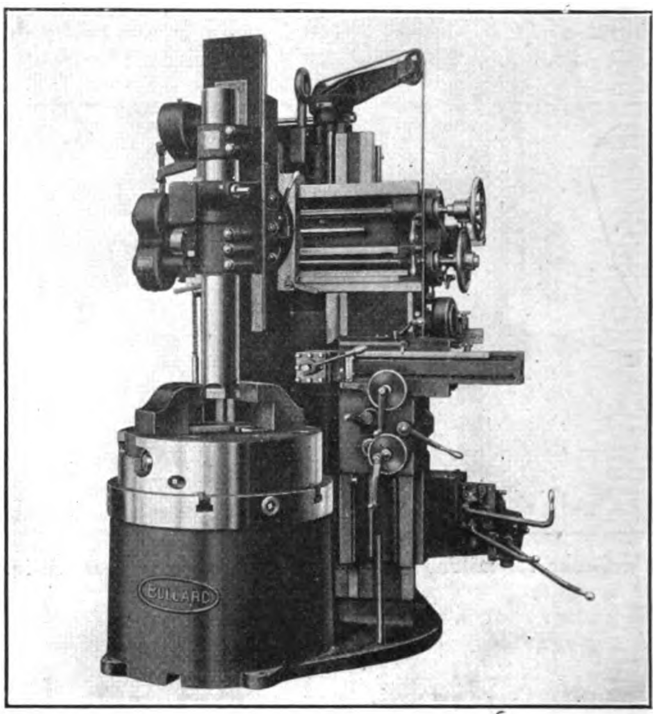
THE standard driving box borer and facer, manufactured by the Bullard Machine Tool Company, Bridgeport, Conn., has been redesigned to increase its adaptability to the various lengths of boxes. The tool support has also been strengthened to permit heavier cuts and greater accuracy.

In place of the "banjo type" main head and boring bar, the machine is provided with a cast steel main slide of extra length designed to clamp and support a heavy steel boring bar of sufficient length to accomodate boxes up to 23 in. The new design provides a heavier support for the bar and cutting tools and an adjustment in the bar extension from the main slide to suit the various lengths of boxes. For the shorter boxes, less extension is required, and, therefore, the cutting tools are supported closer to the point of cutting. This adjustment is readily made by a hand crank through a worm and gear to a rack in the bar. The clamping bolts to the main slide are then firmly secured and the vertical tool feed is obtained through the main slide. The various diameters of boxes are obtained by bringing the main head, bar and cutting tools close to the work by the cross traverse. The dimensions are read directly from the scale and micrometer dials. This avoids excessive overhang or extension of tools from the boring bar.

The machine is also equipped with a heavy two-jaw, self-centering chuck which securely holds the work on the opposed faces. It is also provided with a graduated micrometer cross adjustment for boring reliefs. The chuck is fitted for locating the box accurately on the vertical axis and for holding the cellar in place for boring.

Other standard features include a constant speed drive pulley with a multiple disc clutch and brake for starting and stopping the machine. All speed and feed changes are obtained by sliding gears within the machine itself. The standard Bullard features of centralized control, power rapid traverse for both vertical and cross movement of the main head and constant flow lubrication to all moving parts, are also included in the new design.

Direct reading scales and micrometer dials on the feed rods are of material assistance in gaging and duplicating sizes of work. Recently revised material specifications provide added strength in the driving train of shafts and gears and all other operating and supporting units subject to the strain of heavy cutting.

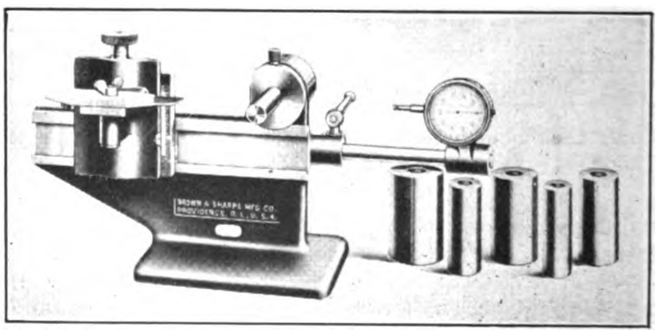


The Bullard driving box borer and facer with a capacity for boxes up to 23 in.

Cutter testing fixture

THE cutter testing fixture shown in the accompanying illustration and manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I., is used conveniently when sharpening gear or other formed cutters or hobs. All sizes of cutters up to 10 in. in diameter are within its capacity.

The testing plate is carried on a vertical slide which makes possible the testing of cutters the cutting faces of which are either radial or undercut. This is a convenient feature as it greatly broadens the use of the fixture. The position of the testing plate is indicated accurately by means of a scale graduated in 0.60 in. One end of the test plate is flat for testing straight gashed cutters and hobs, and the other end is made in the form of a knife-



A device for testing gear cutters or hobs

edge to permit the testing of spiral formed cutters or hobs having spiral gashes. The dial indicator may be furnished to read to thousandths of an inch English measure, or hundredths of a millimetric measure.

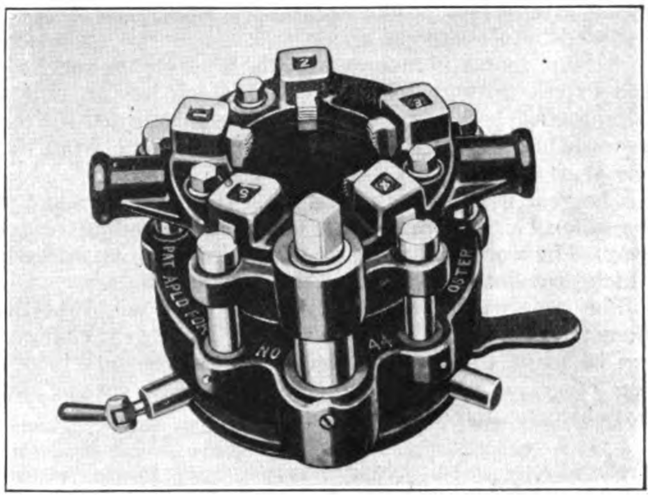
Five hardened and ground bushings are furnished in the following sizes: 7/8 in., 1 in., 1 1/4 in., 1 1/2 in. and 1 3/4 in. diameter. A collar is also provided for use in testing thin cutters.

Die stock for large pipe sizes

An easy cutting pipe threader for the larger sizes of pipe known as the No. 44 Receder has been placed on the market by the Oster Manufacturing Company, Cleveland, Ohio. The tool gets its easy cutting qualities from its narrow dies which are ground with an extra long lead and sharp rake. To further increase the ease of cutting, the tool is geared and is furnished with a ratchet handle so that one man can cut 4-in. pipe, which approaches the maximum size for a railroad shop, without hard work.

A massive leader screw protected by a patented chip shield starts the dies on the pipe and pulls them along, producing the proper pitch and taper. The leader screw, which is of great importance to a tool of this type, is kept free from dirt and chips by means of a shield.

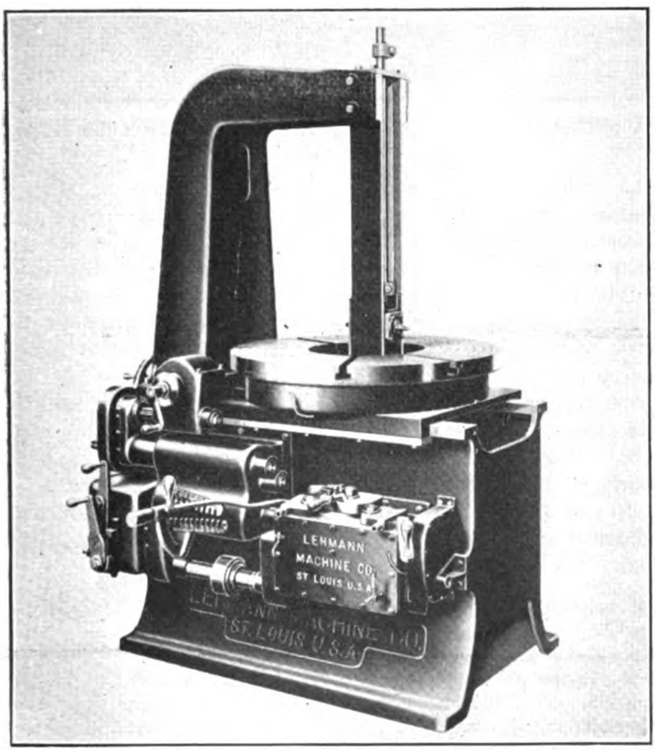
It is possible to cut over and undersize threads as well as to cut standard threads with this tool. A simple rotary movement of the die head adjusts the dies to cut either deep or shallow threads. A lever-operated, self-centering chuck takes the place of, and eliminates the bother of, changing pipe bushings for each size of pipe. The chuck insures a straight, true thread on all sizes from 2 1/2 to 4 in., the range of the tool. The threading of short nipples is possible, as the bore of the stock is large enough to accommodate a 4-in. coupling.



The No. 44 receder which has a capacity for 2 1/2-in. to 4-in. pipe, inclusive

Oil groove milling machine

A machine designed primarily for railroad shop use to mill the oil grooves in driving box crown brasses has recently been placed on the market by the Lehmann Machine Company, Chouteau and Grand avenues, St. Louis, Mo. A head carrying a three-groove end mill of the desired size travels in the slides of the central vertical column. This column is rigidly secured at the bottom and is fastened at the top to the heavy main column which bridges over from the back of the machine, forming a structure sufficiently rigid to withstand the requirements of the maximum demands.



This machine cuts oil grooves in driving box crown brasses

The table is provided with a device for holding the brasses in position and means are provided for easily determining the correct location. The table has a lateral movement so that the brass may be fed against the cutter to produce a groove of the desired depth. The table has a rotary movement which co-ordinates with the vertical movement to cut the diagonal grooves. A feed box with 40 quick changes of feed controls the rotary movement of table, and this is provided with an index indicating the length of straight grooves to which the diagonal grooves are formed. The operator has only to select the length of the straight grooves and drop the plunger of the quick change into the hole which designates this dimension.

The control for the operation is by one handle which, in a central position, gives a straight vertical movement to the head, when moved to the left gives a left diagonal movement, again to the center a vertical movement, and to the right a right diagonal movement, completing the operation with four movements of a single handle. Neutral positions are provided between all the feed positions of this handle.

Steps for both the upper and lower position of the cutter are provided with a graduated index. These are

set, before the operation, for the length of the slot desired, which relieves the operator from the necessity of throwing the control handle at precisely the right time. The feed of the cutter comes to a stop at the extremity of its movements until the control handle is thrown to its succeeding operating position.

The various movements have handles for manual operation or independent power movement for obtaining the setting up positions.

Provision is made for the disposal of chips to the inside of the machine base, which has an opening through which they may be removed. All working parts are protected from chips. The feed screw under the head is enclosed by a telescopic cover.

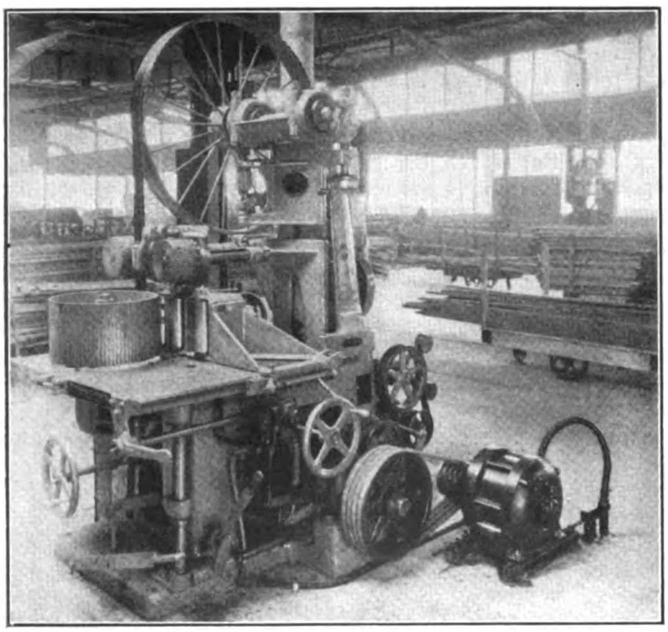
A 5-hp. motor is mounted on the back of the machine and drives through a silent chain which has an oil-retaining cover. A countershaft may be substituted for the motor when it is desired to drive the machine from the line shaft.

The gear boxes are closed and oil retaining, except for the quick change box, which has a central oiling reservoir. The worm and gear on the table run in an oil bath which provides lubrication to the table bearings.

The capacity of the machine is from 7 in. to 14 in. diameter and up to 22 in. in length. Simple gear changes can be made to modify relative feed movements to obtain other oil groove arrangements. Two speeds and two changes of feed are provided.

The Texrope drive

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has recently perfected a new type of short center, flexible drive, known as the Texrope drive. It consists of two grooved sheaves and a number of specially constructed endless V-belts. The



A 15 hp., 1,750 r.p.m. roller bearing motor driving a 550 r.p.m. band resaw through a Texrope drive

sheaves are set just far enough apart so that the belts fit the grooves without either tension or slack. Because of the V-construction, the belts cannot slip, as the harder the pull the more firmly the belts grip the grooves. Being elastic, they cannot jerk either in starting, accelerating or running, nor can they transmit vibrations, but act as cushions between the driving and driven machines.

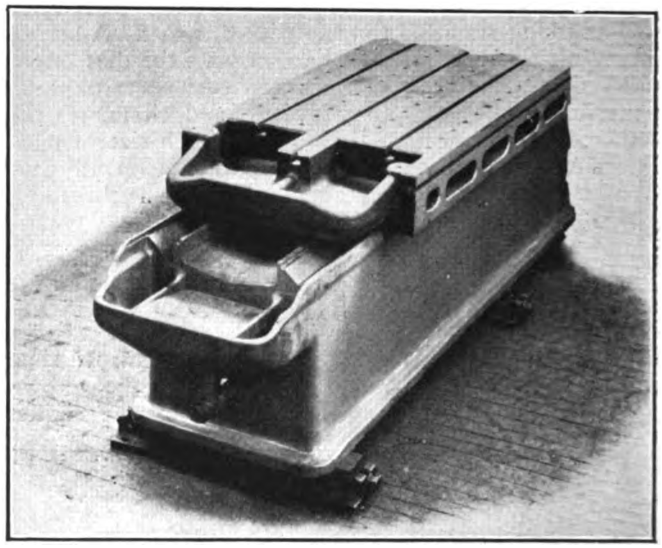
Since no belt tension is employed, the bearing pressures are low. The drive occupies very little space and it is claimed that the drive is unaffected by moisture or dirt. Since there is no slip, the speed ratios are fixed and exact.

Texrope drivers from ½ to 250 hp., with ratios up to 7 to 1 and belt speeds from 800 to 6,000 ft. have already been placed in service.

Inner guide box table for Hypro planers

The planer tables in general use allow chips to fall off the ends of the table into the vees of the bed, especially so when planing near the end of the table. Sometimes this causes considerable damage through chips getting between the bed and table and cutting either one or the other or both. This results in destroying the accuracy of the planer, as well as the looks.

The only way for the operator to avoid this is to stick up a cardboard or fasten a tin or sheet iron cover to the



A pocket is cast integral with the table to catch the chips

end of the table. This is soon bumped out of shape, making an unsightly appearance. It also destroys the joint when the pan or guard is bolted to the table. These bolts usually work loose and allow the guard to rattle.

The new pocket on the end of the table of the Hypro planers, manufactured by the Cincinnati Planer Company, Cincinnati, Ohio, is cast integral with the table, heavy enough to stand rough usage and large enough to catch and carry all the chips that will come off the end of the table. This addition to the design makes a one-piece table of solid construction and neat appearance in harmony with the construction on the end of the bed.

In case the work is extremely high and must be blocked on the end pockets the walls can be used as stops, thus really giving more capacity to the machine.

Automatic Pumping.—"Automatic Pumping" is the title of a new 24-page booklet issued by Barrett, Haentjens & Co., Hazelton, Pa. This edition differs from previous bulletins describing the automatic operation of centrifugal pumps in that the subject is treated from a purely technical standpoint and several new methods of making centrifugal pumps automatic are described.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

The Denver & Rio Grande Western has opened an apprentice school at its shops at Alamosa, Colorado, in which pupils are to be instructed in general car and locomotive repair work.

Sir W. G. Armstrong, Whitworth & Co., Ltd., Newcastle-on-Tyne, have been awarded a contract for the building of 25 heavy freight locomotives and tenders for the Queensland Government Railways. These locomotives, which will be built at the Scotswood Works, Newcastle-on-Tyne, will be shipped to Brisbane fully erected and in running order in accordance with this builder's usual practice.

The safety program of the A. R. A. for the month of September has been issued (circular No. 132) by L. G. Bentley, chairman of the Committee on Education; it embodies those items of the I. C. C. record which cover fatal and non-fatal injuries under the head of (a) collapses, falls of objects, etc., and (b) coupling or uncoupling locomotives, cars, safety chains and hose. While in a sense these are minor items of Tables 71, 72 and 90, the committee believes that no item yet covered by the twelve-months' program will more readily respond to supervision. The slipping or failure of makeshift scaffolds is prominent in the list of causes under the first mentioned class. Second only to the superior authority and influence of the foreman, the trained safety inspector and a strong plant safety committee are of the greatest value in keeping this record low. In coupling and uncoupling, the neglect of men to have a complete understanding of conditions with all of their associates on a given piece of work, is one of the principal causes of failure. It is the duty of trainmasters and yardmasters to see that violations of prescribed precautions are properly punished. Employees who indulge in unsafe practices should be penalized even though no accident occurs.

Continuous train control demonstration on the Michigan Central

On July 13, a demonstration of the continuous type of automatic train control (Clark patents) as manufactured by the Continuous Train Control Corporation, New York, was made on the Michigan Central near Rives Junction, Mich. This test, on a 4,000 ft. track section, with one locomotive, is said to have demonstrated the practicability of the principle of the system, which includes a so-called radio feature. An oscillator delivers a high frequency energy to the rails when the signal is at clear and a different frequency when the signal is at caution, while no energy is delivered when the signal is at stop. The current is picked up by receiver coils on the engine, in a manner somewhat similar to other continuous systems.

Wage increases of approximately one and one-half cents an hour have been granted by the Chicago & Alton to certain of its shopmen, agents and telegraph operators to bring their rates up to a level with those of employees of similar classifications on other roads in the middle west.

Apprentices on Swiss railways have psychological tests

The Swiss Federal Railways, according to the Federal Railways Bulletin, have made psychological tests, as well as other examinations of general knowledge, a prerequisite to acceptance for apprenticeship in the various shop trades.

The general knowledge examination consists of requiring the applicants to reproduce as closely as possible the essential features of a short essay which is read to them; to solve several practical problems and to write an essay on one of several subjects given them to choose from. Papers are graded according to the ideas which are expressed in them, the order in which these ideas are expressed and spelling.

Applicants take the general knowledge examination in groups. Those who pass it satisfactorily are admitted to the psychological examination, which they take as individuals. This examination is designed to test their aptitude for the trade which they wish to learn. It includes a test for the memory of figures, the accuracy of perception, the ability to reason practically from a technical standpoint, the sensibility of muscles of the arm and hand to control the actions of those members, dexterity, and accuracy of a visual estimate. Special texts and apparatus are used for this examination and the conditions are the same for all candidates. This examination not only permits the examiner to learn the practical abilities of the young man, but also to penetrate his personality.

After these two examinations a choice to fill vacancies is made from the most apt, who are then given a physical examination which, if passed, admits them to full apprenticeship. Experience in the shop of these young men during the probationary period has borne out the efficacy of these tests in admitting only those suited to the work. A group so admitted to the Olten shops in the spring of 1925 after six months were graded as follows: 29 per cent, "very good"; 47 per cent, "good"; 24 per cent, "fairly good." Not one of the young men received the lowest passing mark which is "satisfactory."

New equipment

Class I railroads during the first five months this year installed in service 933 locomotives, according to reports compiled by the Car Service Division of the American Railway Association. This was an increase of 185 over the number installed during the corresponding period last year and an increase of 22 over the corresponding period in 1924. It was, however, a decrease of 764 compared with the corresponding period in 1923.

Locomotives on order on June 1 this year totaled 612, compared with 329 on the same date last year and 447 on the same date in 1924. On June 1, 1923, however, 2,041 locomotives were on order.

During the first five months the railroads also placed in service 42,300 freight cars, of which 10,320 were installed during May. Of the total 20,673 were box cars, 16,628 were coal cars and 2,666 were refrigerator cars.

The total number installed from January 1 to May 31 this year, was a decrease, however, of 28,649 as compared with the number placed in service during the corresponding period last year and a decrease of 16,255 under the number placed in service in 1924.

The railroads on June 1 this year had 44,628 freight cars on order, an increase of 8,113 over the number on order on the same date last year but a decrease of 16,628 under the number on order on June 1, 1924.

These figures as to freight cars and locomotives include new and leased equipment.

New construction

Chicago & Eastern Illinois.—A contract has been awarded to G. A. Johnson & Son, Chicago, for the construction of an engine terminal at Evansville, Ind.

Norfolk & Western.—This company has awarded a contract to J. P. Pettyjohn & Co., Lynchburg, Va., for the construction

of a roundhouse and machine shop at Williamson, W. Va., to cost approximately $115,000.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—A contract has been awarded to T. & L. B. Libby, Minneapolis, Minn., for the construction of an addition to the enginehouse at St. James, Minn., at an estimated cost of $50,000.

MISSOURI PACIFIC.—A repair shop will be constructed at Hot Springs, Ark., and other improvements will be made at this point including the construction of two heating plants, two train sheds long enough to accommodate trains of 18 and 19 cars, a 50,000-gal. water tank and the installation of a large cinder conveyor. The passenger station will be remodeled also. The improvements at Hot Springs are expected to cost approximately $200,000.

MAINE CENTRAL.—This company has authorized the installation of a new wheel shop, blacksmith shop and passenger car repair track at Rigby, Me., and the transfer of machinery and tools to that place from Thompson's Point, Me. The project will cost approximately $72,000. It has also authorized the replacement of the old wheel shop and wash room building by a new shop, and the installation of new and second-hand machinery and a new transfer table at Waterville, Me., to cost approximately $83,000.

Master Blacksmiths Supply Men's Asociation elect officers for 1927

A total of 16 railway supply companies were represented at the thirtieth annual convention of the International Railroad Master Blacksmiths' Association held August 17, 18 and 19, 1926, at Hotel Winton, Cleveland, Ohio. The annual meeting of the Supply Men's Association was held on the last day of the convention at which time the following officers were elected to serve for the ensuing year: President, A. N. Lucas, Oxweld Railway Service Company; vice-president, C. D. Harmon, National Machinery Company; secretary-treasurer, W. R. Walsh, Ewald Iron Company. The following is a list of the exhibitors and representatives:

Acme Machinery Company, Cleveland, Ohio—Literature on bolt and forging machines. Represented by C. R. Davis, H. M. Anderson and C. E. Smith.

Ajax Manufacturing Company, Euclid, Ohio—Model of Ajax forging machine, forgings and literature. Represented by J. R. Blakeslee, W. W. Criley, G. G. Fristoe, A. L. Guilford, H. D. Heman and J. A. Murray.

Anti-Borax Compound Company, Fort Wayne, Ind.—Welding compounds and literature. Represented by C. O. Kahre.

Colonial Steel Company, Pittsburgh, Pa.—Literature on alloy and carbon tool steels. Represented by C. Carnahan, E. W. Thurber.

Crucible Steel Company of America, Pittsburgh, Pa.—Literature on dies, taps and high speed and special tool steel. Represented by F. Baskerfield, P. J. Connor, A. E. Jones and W. M. Stevenson.

DeRemer Blatchford Company, Chicago—Represented by C. P. Nye and G. P. White.

Ewald Iron Company, Louisville, Ky.—Represented by R. F. Kilpatrick, W. R. Walsh.

Firth Sterling Steel Company, McKeesport, Pa.—Literature on bolt and rivet dies. Represented by W. C. Royce, C. E. Hughes, Alan Jackman, E. T. Jackman, T. A. Larecy and W. A. Nungester.

Heppenstahl Forge & Knife Company, Pittsburgh, Pa.

Houghton, E. F. and Company, Philadelphia, Pa.—Railway springs, quenching oils, "drawtemp" literature. Represented by C. W. Nohl.

Metal & Thermit Corporation, New York—Specimens of thermit welding, literature. Represented by E. W. Bloom and H. D. Kelley.

National Machinery Company, Tiffin, Ohio—Specimens of machine forging work, literature. Represented by K. L. Ernest, C. D. Harman and H. E. Lott.

Oxweld Railway Service Company, Chicago—Oxy-acetylene welding equipment, literature. Represented by A. N. Lucas, C. E. Allen, G. M. Crownover, R. R. Kester, W. R. Montgomery and G. V. Rainey.

Pilot Pack Company, Chicago—Packing, literature. Represented by W. W. Bacon and J. Sinkler.

Railway Journal, Chicago—Copies of publication. Represented by E. C. Cook.

Railway Mechanical Engineer, New York—Copies of publication and books. Represented by H. C. Wilcox.

Rockwell, W. S. Company, New York—Oil and gas burners, forging and heat treating furnaces, literature.

Vanadium Alloys Steel Company—Literature on alloy steels. Represented by R. R. Artz.

Meetings and Conventions

National Machine Tool Builders' expositon

The National Machine Tool Builders' Association will hold, September 19 to 24 inclusive, in the Public Hall, Cleveland, Ohio, its first exposition of machine tools, or machinery, equipment, supplies, accessories, material, services, or other articles, methods or processes essential or incidental to the industrial utilization of modern machine tools. A basic feature of the exposition will be the exclusion of the general public—of all persons not having a reasonably direct interest in machine tools and their accessories. By commercial, industrial or technical registration, identification only any interested persons may obtain admission. Therefore, the exposition will be a concentration for the serious purpose of inspection and buying of machine tool users.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS' COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 14-16, Book-Cadillac Hotel, Detroit, Mich.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention September 20-24, Municipal Pier, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. Building.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway. Clearing Station, Chicago. Convention September 21, 22 and 23. Hotel Sherman, Chicago.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capital Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention September 7-10, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month. Terminal Hotel Bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 W. Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The American Steel Foundries has moved its St. Louis office from the Frisco building to the Railway Exchange building.

The Timken Roller Bearing Company will construct an extension to its plant at Canton, Ohio, estimated to cost $1,000,000.

Thorsten E. Dahlberg, one of the founders of the Celotex Company and assistant to the president until 1924, died at El Paso, Texas, on July 27.

The Oakley Chemical Company, 22 Thames street, New York, has changed its name to Oakite Products, Inc. The personnel of the company remains the same.

The Reading Iron Company, Reading, Pa., has opened an office at 721 Pioneer Trust building, Kansas City, Mo., and will be directly represented by O. R. Lane.

V. V. Casey will represent the Bonney Forge & Tool Works, Allentown, Pa., in Pennsylvania, southern New York, Maryland, District of Columbia and New Jersey.

The Locomotive Firebox Company, Chicago, has opened an office at 30 East Forty-second street, New York, in charge of George N. De Guire, assistant to the president.

The Bridgeport Brass Company has removed its New York City office from the Pershing Square building to the Farmers' Loan & Trust Company building, 475 Fifth avenue.

H. G. Steinbrenner has been elected second vice-president of the Brown Hoisting Machinery Company, Cleveland, Ohio, and will have charge of the marketing of the company's products.

Charles F. Palmer has been appointed manager of sales of the Pittsburgh Steel Products Company, Pittsburgh, Pa. C. H. Van Allen has been appointed manager of the Chicago office to succeed Mr. Palmer.

F. A. Whitten, formerly chief engineer of the General Motors Truck Company, Detroit, Mich., has been appointed engineer in charge of design and development of the American Car & Foundry Motors Company, Detroit.

R. F. Stubblebine, railway sales engineer of the Hale-Kilburn Company, Philadelphia, Pa., has been appointed eastern sales manager with headquarters at 30 Church street, New York, succeeding A. F. Old, deceased.

C. R. Ahrens, formerly eastern sales representative of the Chicago Railway Signal & Supply Company, has been appointed eastern sales representative of the Illinois Iron & Bolt Company, with headquarters at 30 Church street, New York.

L. N. Ridenour has been appointed special factory representative of the Harnischfeger Corporation, Milwaukee, Wis., and E. L. Fuckett, Richmond, Va., has been appointed district manager of the Harnischfeger Corporation's Charlotte, N. C., office.

Robert I. Fretz, for the past year in charge of boiler tube sales of the Reading Iron Company, Reading, Pa., has been appointed district sales manager of pipe sales in the Reading district which embraces New York state, excluding New York City and eastern Pennsylvania, excluding Philadelphia. Mr. Fretz succeeds R. L. M. Taylor, who has resigned.

The Ohio Brass Company is now manufacturing its regular and special types of its gas-weld signal bonds with either steel or copper terminals. Heretofore the bonds have been made only with steel terminals but changing conditions have created a new set of requirements and the copper terminals are added to complete the line of signal bonds.

H. H. Pleasance, vice-president and sales manager of the United Alloy Steel Corporation, Canton, Ohio, has resigned that position to become affiliated with the Bourne-Fuller Company, and George H. Charls, president, has resigned following the merger of the United Alloy Steel Corporation with which he was connected, with the Central Alloy Steel Corporation.

Arthur H. Weston has been appointed representative of the Clark Car Company, with headquarters in the American National Bank building, Richmond, Va. He will handle the company's business in the states of Maryland, Virginia, North Carolina and South Carolina. Mr. Weston was formerly, for many years, sales engineer for the Symington Company, and more recently vice-president of the Car Devices Company.

Frans H. C. Coppus has resigned as president and treasurer of the Coppus Engineering Corporation, Worcester, Mass., in order to devote most of his time to railway equipment under the firm name of Coppus Locomotive Equipment Company, Worcester, Mass. The Coppus Engineering Corporation has assigned to Mr. Coppus its rights and interests pertaining to this line. Mr. Coppus will be identified with the Coppus Engineering Corporation in a consulting capacity and as chairman of the board, retaining also his financial interest in the corporation. Otto Wechsberg, formerly general manager, is now president and general manager, and Jerome R. George, Jr., is treasurer of the Coppus Engineering Corporation.

The Keith Car & Manufacturing Company, Sagamore, Mass., has acquired a majority of the common stock of the Standard Tank Car Company, of Sharon, Pa. The directors of the company are: W. J. McKee, vice-president of the Keith Car & Manufacturing Company; Ebon S. Keith, president of the Keith Car & Manufacturing Company; William M. Robinson and John G. Frazer of the firm of Reed, Smith, Shaw & McClay, Pittsburgh, Pa.; E. A. MacDonald, treasurer of the Standard Tank Car Company; H. C. Rorick of Spitzer, Rorick & Co., Toledo, Ohio, and H. E. Coyl, vice-president of the Standard Transit Company. The officers of the company are: W. J. McKee, president; E. A. MacDonald, secretary and treasurer and J. W. Keefe, auditor. The principal executive office will remain at Sharon, Pa. The Standard Tank Car Company owns the capital stock of the Standard Transit Company, whose directors are the same as those of the Standard Tank Car Company and the officers are the same with the addition of H. E. Coyl, vice-president.

Joseph Robinson, Inc., has been organized to own and manage all United States and foreign patent rights for the Robinson automatic air and steam hose connector, a $1,200,000 development. Mr. Robinson, who previously owned these rights individually, has transferred them all to the company. The capitalization of the company is 1,500 no par value cumulative preferred shares, and 25,000 no par value common shares. The officers are: Joseph Robinson, president; G. E. Matheson, vice-president; J. H. Rogers, secretary and treasurer. The directors are: J. H. Rogers, president, British American Trading Corporation; R. M. Wolvin, president, British Empire Steel Corporation; E. W. Poindexter; L. J. Howarth, treasurer, Liberty Trust Company, and Joseph Robinson. The company's patent rights will be worked under license to an operating company, plans for which are progressing. The office of the company is in New York. At a recent meeting of the board of directors, Joseph Robinson, inventor of the Robinson automatic connector, was elected president of the Joseph Robinson, Inc. Mr. Robinson was born at Dayton, Wash., on July 21, 1889, and was educated in the common schools. He began his engineering career as a blacksmith, going through machine shop and foundry practice to the drafting board, and from there into research and development engineering. While his engineering developments are extensive, Mr. Robinson is best known for his invention and development of the Robinson automatic air and steam hose connector.

Joseph Robinson

LaMonte Judson Belnap, has been elected president of the Worthington Pump & Machinery Corporation, New York, and C. Philip Coleman, retiring president, has been elected chairman of the board. Mr. Belnap was born at Burr Oak, Mich., on November 7, 1877. He was educated in the public schools of Lincoln, Neb., and afterwards attended the University of Nebraska, from which he was graduated in 1898 with the degree of B. S. in E. E. During his college course he was employed for four years during the summer vacations on survey and construction work on the Chicago, Burlington & Quincy, in Montana and Wyoming, and soon after graduation, entered the employ of the Western Electric Company, at Chicago, as a student apprentice. He later became associated in various technical, sales and managerial capacities with the Wagner Electric Manufacturing Company, St. Louis, the Bullock Electric Manufacturing Company, at Cincinnati, and the Allis-Chalmers Company at Milwaukee and Montreal. In 1911, Mr. Belnap left the Allis-Chalmers Company and became vice-president of the Rudel-Belnap Machinery Corporation, Ltd., Montreal, retaining his interest in this company until 1925. Simultaneously with his work in the Rudel-Belnap Company, he organized in 1914 the Ingersoll Machine Company, Ltd., of Canada, of which company he was president until 1920; also, from 1917 to 1919 he was managing director of the Williams Manufacturing Company, Ltd., of Montreal, and from 1919 to 1925, was president of the Rolls-Royce Company of America at Springfield, Mass. In 1925 and 1926 he was chairman of the board of the Wills Sainte Claire Company, of Marysville, Mich. When the United States entered the war the British War Mission in Washington was organized and Mr. Belnap served as its assistant director, and in addition to his duties there he was actively engaged at the same time on war orders with the Williams Manufacturing Company, Ltd., at Montreal.

L. J. Belnap

The Pyrotung Manufacturing Company has recently been organized and a new plant built at 730 W. 50th St., Chicago, for the manufacture of railroad track drills and shop cutting tools. These tools are made by the new Pyrotung process, designed to give unusual toughness and hardness without brittleness. The officers of the new company are: W. R. Otis, president; C. E. Sutten, vice-president; B. C. Cleveland, vice-president and metallurgical engineer; and C. E. Pynchon, general manager, who was formerly manager of the machinery and tools departments of J. T. Ryerson & Son., Inc.

Charles A. Coffin

Charles A. Coffin, founder and for 30 years head of the General Electric Company, Schenectady, N. Y., as president and chairman of the board of directors, died on July 14 at his home in Locust Valley, Long Island, N. Y. Up to within two weeks of his death Mr. Coffin had been regularly to his office in New York and continued his active interest in the progress of the electrical industry and more particularly the General Electric Company, of which he was a director.

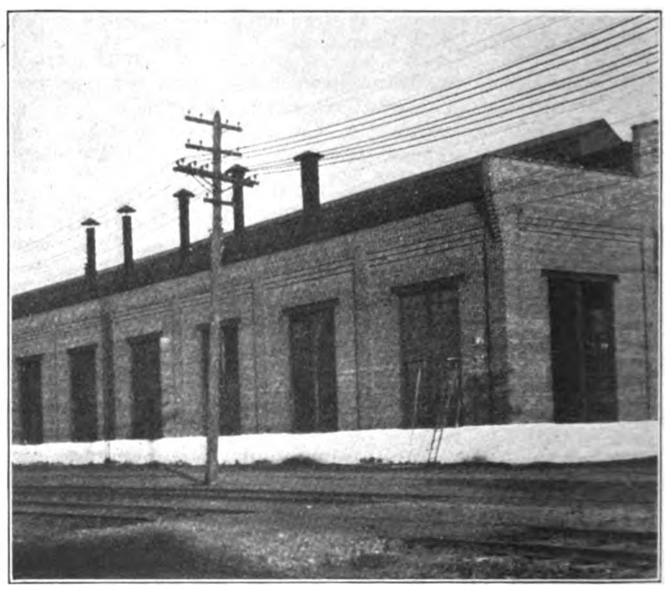
Charles Albert Coffin was for 30 years the financial and commercial genius of the General Electric Company. Prior to the formation of that company, in 1892, he was with the Thomson-Houston Electric Company, one of the predecessors of General Electric. Mr. Coffin was born in December, 1844, in Somerset county, Maine, and graduated from Bloomfield (Me.) Academy. He went to Boston as a young man and became interested in the shoe and leather industry. Mr. Coffin, with Micajah P. Clough, formed the firm of Coffin & Clough, and established a factory at Lynn, Mass., one of the largest shoe manufacturing centers in New England.

In 1883 Mr. Coffin became interested in the purchase of the American Electric Company of New Britain, Conn., a small concern, the head of which was Professor Elihu Thomson. The business was moved to Lynn and the name changed to the Thomson-Houston Electric Company in honor of Professor Thomson and his early associate, Professor Edwin J. Houston. Mr. Coffin became its vice-president and treasurer, and through his leadership the company developed the central station idea as applied to arc lighting. In 1888, he induced the company to enter the electric railway field, manufacturing equipment for electric street car lines in many parts of the country. A number of other electrical concerns were absorbed, and in 1892 the Thomson-Houston Company was consolidated with the Edison General Electric Company of New York under the name of General Electric Company. Mr. Coffin was immediately elected president, and directed its affairs for the succeeding twenty-one years.

During the electrical development of the late nineties and early years of the new century, he continued to exercise strong and inspiring leadership. He supported the work of his company's engineers in developing the Curtis steam turbine, which revolutionized the primary power sources in electric light and power stations, and he endorsed the movement to establish, in 1901 a laboratory for electro-chemical research which grew to be the research laboratory of today.

Mr. Coffin retired from the presidency of the company in 1913, but became chairman of the board of directors, remaining in active participation in the company's affairs until 1922. In 1915 he was engaged in organizing the War Relief Clearing House for France and her allies. This was later consolidated with the American Red Cross in which Mr. Coffin was active throughout the World War.

He was a director in the General Electric Company, the International General Electric Company, the British Thomson-Houston Company, the Companie Francaise pour l'Exploration des Procedes Thomson-Houston, the Electric Bond & Share Company, the Electrical Securities Corporation, the American International Corporation, the Illuminating & Power Securities Corporation and the Union Carbide & Carbon Corporation. He was an officer of the Legion of Honor, of France; a commander at one time of the Order of Leopold II, of Belgium; a member of the Order of Saint Sara, of Servia, and had served as a vice-president of the Chamber of Commerce of New York and a member of the Merchants' Association of New York. Mr. Coffin was made an honorary member of the Franklin Institute of Philadelphia, in 1924.



Blacksmith shop located at the North Billerica shops of the Boston & Maine, showing the effects of the use of whitewash

Trade Publications

Valves.—The O-B lines of valves are pictured in a folder which has just been issued by the Ohio Brass Company, Mansfield, Ohio.

Gas compressors.—Bulletin No. 83-C descriptive of Sullivan belt-driven single and two-stage gas compressors has been issued by the Sullivan Machinery Company, 122 S. Michigan avenue, Chicago.

Air filter.—The Phoenix automatic constant-effect air filter is illustrated and described in a bulletin issued by the Drying Systems, Inc., 1800 Foster avenue, Chicago. This equipment is electrically operated.

Expansion reamer.—The No. 717 spiral flute expansion reamer is fully described and illustrated in a four-page circular being distributed by the Morse Twist Drill & Machine Company, New Bedford, Mass.

Whiting products.—A broadside on its electric drop pit table, showing results obtained in actual use, has been issued by the Whiting Corporation, Harvey, Ill. The standard building clearances for Whiting overhead electric traveling cranes are given in Bulletin No. 176.

Rigidmil.—The detail construction and operation of the Rockford Rigidmil is described in a 30-page, illustrated catalogue which has been issued by the Rockford Milling Machine Company, Rockford, Ill. The Rockford rotary Rigidmil and vertical attachment is also described.

Machine tools.—Four circulars descriptive of the construction and operation of the Niles 90-in. quartering machine, the Niles car wheel borer, the Niles 90-in. journal turning lathe and Time-Saver planers, respectively, have been issued by the Niles Tool Works Company, Hamilton, Ohio.

Grinders.—Twenty-six to 38-in., Styles E and F grinders, suitable for planer or other knives designed especially for mills, factories or shops employing knives or small circular rip saws in a limited way, are described in a four-page folder which has been issued by the Machinery Company of America, Big Rapids, Mich.

The spindle book.—The second edition of "The Spindle Book" has just been issued by the Jacobs Manufacturing Company, Hartford, Conn. This booklet contains 95 pages, illustrating and giving the principal dimensions, manufacturers' names and information concerning equipment upon which drill chucks are used.

Conoidal fans.—The Buffalo Forge Company, Buffalo, N. Y., has issued catalogue No. 475 describing in detail the construction of its series of Baby conoidal fans which are built in sizes delivering from 78 to 6,850 cu. ft. per min. The Buffalo Type FB variable and constant speed electric blowers are described in a four-page bulletin, Form No. 2386.

Hoisting and hauling.—A 16 page booklet entitled "Handy hoisting and hauling," has been issued by the Sullivan Machinery Company, 122 South Michigan avenue, Chicago. The service rendered by the Sullivan Turbinair steam and electric portable hoists is described in this booklet which shows many of the uses to which these hoists have been adapted.

Nickel steel.—Bulletin No. 6, giving comparative costs of producing commercial forgings with carbon steel and nickel steel die blocks and the savings effected by the use of the latter material, has been issued by the International Nickel Company, 67 Wall street, New York. Bulletin No. 7 is descriptive of automobile design and automotive steels.

Gages.—The installation and details of construction of a new line of pointer gages for draft, pressure and differentials are described in the catalogue which has just been issued by the Hays Corporation, Michigan City, Ind. These gages are provided with large illuminated scales having uniform divisions and heavy black figures, and can be read at a distance from 50 to 100 ft.

Welding and cutting apparatus.—The Purox Company, Denver, Colo., has issued catalogue No. 6 descriptive of its apparatus for welding and cutting metals. The oxygen-acetylene welding process is briefly described, also the points and principles used in the design and construction of the Purox equipment. An apparatus and supplies price list accompanies this catalogue.

Turret lathes.—The Jones & Lamson Machine Company, Springfield, Vt., has issued a two-page leaflet announcing a new size Hartness flat turret lathe known as the 4 in. by 34 in. The machine is a development of the 3 in. by 36 in. turret lathe. It has added size capacity and such additional pulling power, weight and rigidity as are desirable for the larger work to be turned.

Electric locomotives.—Circular No. 400, giving a survey of the most important improvements which have been realized with electric locomotives equipped with the new Brown-Boveri individual axle drive, has been issued by the American Brown-Boveri Electric Corporation, 165 Broadway, New York. Cross-sectional drawings show the leading dimensions and axle pressures of the 2D2 locomotives for the Paris-Orleans Railway.

Electrical progress.—"Industry's Electrical Progress" is the title of Publication No. C-37 which has recently been issued by the Cutler-Hammer Mfg. Co., 1266 St. Paul avenue, Milwaukee, Wis. A number of examples of production economies obtained through the use of the C-H controller in various industries are outlined in this publication, also the duty of motor controllers and the problems to be considered when ordering motor-driven equipment.

Malleable iron.—The American Malleable Castings Association, Union Trust building, Cleveland, Ohio, has issued a 30-page booklet clearly explaining the origin, development, valuable properties, method of manufacture and uses of certified malleable iron. It has been prepared particularly for the executive interested in costs and profits; the engineer designer interested in efficiency and performance, and the student interested in the many forms of iron and its uses.

Whiting products.—A condensed catalogue of equipment manufactured by the Whiting Corporation and its subsidiaries for use in foundries, steel plants, power stations, railroad shops, chemical works and other industries, has been issued by the Whiting Corporation, Harvey, Ill. The catalogue (No. 175) is attractively arranged and contains many photographs showing the standard line of Whiting cranes and foundry equipment in operation, also the various specialties and products of the Whiting subsidiaries.

Vertical engines.—Bulletins No. 302B, 601 and 801 have been issued by Engberg's Electric & Mechanical Works, St. Joseph, Mich. Horsepower tables for vertical enclosed self-oiling engines are given in Bulletin No. 302B, which is a supplement to Bulletin No. 302 in which the Engberg engines are fully described and illustrated. Direct and alternating current generators and their application to internal combustion engines are fully described and illustrated in Bulletin No. 601. Bulletin No. 801 covers Engberg alternating current, direct-connected generating sets.

Wrought steel wheels.—The contours of two designs of light-weight wrought steel wheels for use under light-wheel freight cars are shown in a booklet being issued by the Carnegie Steel Company, Pittsburgh, Pa. These light-weight wheels are forged and rolled under the same conditions and by the same methods obtaining in the manufacture of the Carnegie wrought steel wheels for heavier service, their design only having been revised in all its dimensions to meet the actual service requirements and to give a minimum weight of metal without sacrificing safety.

Pulverzone.—The CoKal Stoker Corporation, Wrigley building, Chicago, has issued a bulletin descriptive of its newest type of coal-burning equipment—the Pulverzone. This apparatus combines in one the three approved methods of burning coal: (1) Pulverized coal burning; (2) spread method, and (3) coking method. In this way the Pulverzone is able to burn the smaller lumps and fines in suspension as with powdered coal burning. The heavier coal falls down at the front, while the intermediate sizes are automatically spread over the rear section of the fuel bed. The standard coking method of the CoKal stoker is retained.

Water and oil standpipes.—A graphic method of determining water standpipe capacities is a feature of an attractive 48-page bulletin recently issued by Fairbanks, Morse & Co., 900 S.

Wabash avenue, Chicago. The new method is designed to assist railway water departments in making rapid and simple calculations of standpipe and supply-main sizes, tank heights, etc. It consists of a series of six charts which reduce such calculations to graphic form. Other features of the bulletin include a discussion of the influence of water hammer on standpipe design, a listing of the features of Sheffield standpipes for water and oil service, and 16 pages of engineering data and tables for use in connection with making installations of water-supply systems for standpipe and similar service.

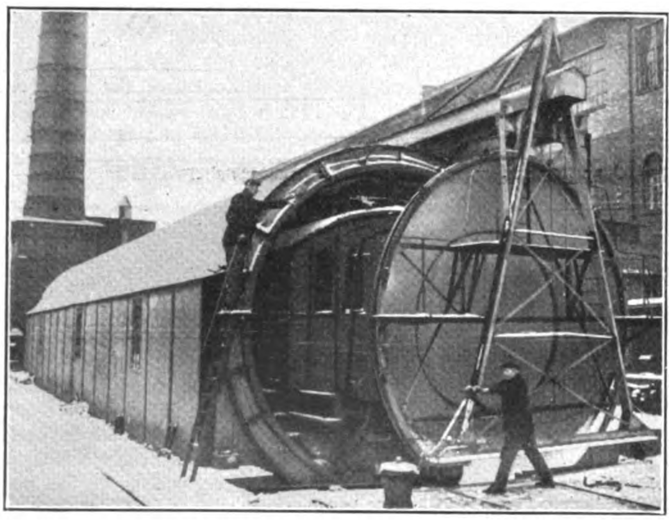
Power transmission.—A new catalogue, containing information pertaining to power transmission and engineering has just been issued by the Hill Clutch Machine & Foundry Company, Cleveland, Ohio. This catalogue, No. 26, is printed in three sections, A, B and C.

Section 26-A illustrates and describes a new flexible coupling of unique simplicity, flanged and compression coupling, shafting and bearings. A large part of this section is devoted to the illustration and description of the Cleveland type oil film bearings, in which the rotating shaft or journal is supported without metallic contact, on a nearly frictionless film of oil. Complete data is given on a heavy duty form of this bearing. Another item in this section is an improved type of clamp for securing bearings to structural steel without the necessity of drilling holes.

Section 26-B covers fully the application of the patented Smith type Hill clutch pulleys and cut-off couplings including quill drives. A complete horsepower table is presented from which friction clutch or plain pulleys may be chosen to meet any requirements. Full data and dimension tables enable the designer to incorporate any of the standard forms of Smith type Hill clutches in power transmission layouts. Following pages take up transmission of power by belting, giving formulas and tables covering the horsepower of leather belting. Applications of belt tighteners to secure maximum horsepower transmitted is discussed in detail. The application of the new Steelarm automatic belt tightener, which provides means of scientifically controlling belt slip, is also described.

Section 26-C illustrates and describes both the American and English systems of rope drives; agitator designs, parts and gearing; forged-cast, iron cast tooth, and cut spur and bevel gears; industrial type speed transformers; and a wealth of pertinent engineering data such as bolt strengths and dimensions, pipe dimensions, threads and tap drills, sheet and wire gages, fusion temperatures, tables of allowable loads on structural shapes, concrete data, trigonometric functions, areas and circumferences of circles, etc.

The three sections of catalogue No. 26 have a total of 258 pages and are substantially bound. Each section is profusely illustrated and line drawings of individual products furnish controlling dimensions of all sizes.



Sterilized transportation—The German State Railways disinfect all of its passenger cars in such chambers as the one shown in the illustration at regular intervals

Personal Mention

General

B. H. Gray, superintendent of motive power of the Gulf, Mobile & Northern, with headquarters at Mobile, Ala., has been appointed superintendent of motive power of the Jackson & Eastern, with the same headquarters, pursuant to the acquisition of control of this property by the Gulf, Mobile & Northern.

John W. McVey, until recently general superintendent of motive power of the Consolidated Railroads of Cuba, has been appointed research engineer in the mechanical department of the Boston & Maine, with headquarters at Boston, Mass. In his new position Mr. McVey will be concerned with general research activities, with the object of securing increased efficiency, and of studying the application of suggestions advanced by employees.

Master Mechanics and Road Foremen

H. M. Odaee has been appointed master mechanic of the McCook division of the Missouri Pacific.

E. R. Dowdy has been appointed master mechanic of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding F. B. Moss, deceased.

G. B. Pauley has been appointed master mechanic of the Chicago, Burlington & Quincy, with headquarters at Alliance, Nebr., succeeding O. E. Ward.

G. P. Trachta, roundhouse foreman of the Chicago, Burlington & Quincy at Kansas City, Mo., has been appointed master mechanic, with headquarters at Omaha, Nebr., succeeding G. B. Pauley.

Shop and Enginehouse

C. W. Buffington has been appointed general master boilermaker of the Chesapeake & Ohio, with jurisdiction over the system in charge of inspection and maintenance of boilers. Mr. Buffington's headquarters are at Richmond, Va.

Obituary

Frank A. Torrey, formerly general superintendent of motive power of the Chicago, Burlington & Quincy, who retired on November 1, 1922, after 48 years of railway service, died at his home in LaGrange, Ill., on July 29. He was born in Pennsylvania on October 6, 1856, and entered the service of the Burlington in 1874 as an apprentice in the machine shop at Burlington, Iowa. He was later employed as a locomotive fireman and as a locomotive engineer and was made road foreman of engines in February, 1887. Mr. Torrey was promoted to master mechanic of the Ottumwa division on April 1, 1889, and was transferred to the Creston division in March, 1902. On September 1, 1903, he was made assistant superintendent of motive power, with headquarters at Chicago, and two years later was promoted to superintendent of motive power of the lines east of the Missouri river. Mr. Torrey was appointed general superintendent of motive power of the system on January 1, 1911, and held that position until his retirement.

F. A. Torrey

Railway Mechanical Engineer

Volume 100 OCTOBER, 1926 No. 10

Table of Contents

**Beginning in the November issue—
A description of the operating methods used in the Sayre shops of the Lehigh Valley—Modern personnel methods have been a big factor in increasing production of these shops**

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
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Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00. When paid through the London office, 34 Victoria Street, S. W. 1, 17s. 0d. Single copy 35 cents, or 1s. 6d.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

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RYERSON RAILROAD SERVICE

Railway Mechanical Engineer

Vol. 100 October, 1926 No. 10

Proper painting saves maintenance

It was pointed out by two of the speakers at the recent convention of the Equipment Painting Section at Detroit that the possibilities for those in charge of equipment painting to effect economies in operation are greater than at any time in the past. The statement was made by a master car builder some time ago that the out-of-shop time of a passenger car is to a great extent dependent upon the life of its paint. The importance of protective coatings has materially increased since the advent of steel equipment due to the tendency toward rapid deterioration of unprotected steel surfaces.

The Equipment Painting Section, as evidenced by the reports presented at the recent convention, has recognized that changes are taking place in the development of protective materials and methods for their application and shows a marked spirit of progressiveness in anticipating the economies that may be expected from the use of improved materials and methods. Probably the most interesting discussion during the recent convention concerned the rapid development of the use of lacquer finishes. The fact that it is one of the most important of the recent developments in the painting field should assure the presentation of a great deal of interesting material on its use at next year's meeting in Louisville. The work of the Equipment Painting Section has been more or less in the background as compared with the work of some of the other branches of the mechanical department, but the importance of this phase of railway equipment maintenance is constantly growing. Upon the proper protection of surfaces will depend, to a great extent, the increase in service life of rolling stock and mechanical officers in charge of car work will find more and more to interest them in the association which is foremost in guiding the development of new and improved methods of equipment painting.

Books to read

We have had frequent requests for information as to books which would be helpful to officers, supervisors and foremen in getting a better understanding of the human relations problem or assist them in improving their leadership ability. Many books are now being published on problems of industrial management and industrial leadership. The extent to which they can be helpful to the practical man in industry and transportation, of course, depends upon the man's particular experience and viewpoint. It must be remembered that improvements in industrial management have been going forward rapidly in recent years, as the human relations problem has become better understood and its vital relationship to industry has been more clearly recognized. Just as the physician or scientist must keep in touch with improvements and progress in his particular field, so the industrial executive and foreman must deliberately plan to study progress in the field of management and leadership. This publication has consistently tried to keep its readers informed on these questions. It is trying to make itself still more useful by calling attention, in a series of articles to be published regularly, to what it conceives to be the latest and best books on these subjects which will be helpful to railroad officers and foremen. The second article of the series appears elsewhere in this number. Is this sort of thing helpful to you? Have you any concrete suggestions as to the particular type of books that you would like to see reviewed in these columns? It will encourage and assist the editors if you will let them know of books which have been particularly helpful to you in your work. One mechanical superintendent has called our attention to a particular book with this notation: "You will enjoy this—the man problem is much discussed." We shall have something to say about this book in our November number.

General Foremen can exert great influence

Those attending the recent convention of the International Railway General Foremen's Association in Chicago could not help but be impressed by the increasing influence exerted by organizations such as this. Last year's officers of this association are to be commended on the excellent program which was presented and its reception should encourage the new officers to broaden the scope of the association's work. The General Foremen's Associafion needs the assistance which a larger membership will give it and its officers have demonstrated the organization's ability to be of such valuable assistance in the promotion of mechanical department interests as to warrant the support of every eligible supervisor.

Big problems are before the mechanical departments which must be solved. In the subjects at the recent convention it may be seen that this association has recognized the growing importance of such factors as shop production, machine tools and foreman and apprentice training. One speaker told of the vital necessity of stabilizing employment and of making improvements in wage payment and cost data systems. The responsibility for the solution of such problems must rest with those men who are close to prevailing conditions in the shop—and who comes in any closer contact with all phases of shop operation than the general foreman?

The balancing of shop sub-departments—one of the topics—is of far greater importance than at first it may seem. A properly balanced shop is one having an organization which will produce maximum output within a minimum time. Proper organization results in a healthy reduction of force to a point where maximum and minimum demands may be met with no great fluctuations in

the number of men required. The solution of one problem therefore may be a contributing factor in the solution of the more difficult and important problems.

Machine tools as a factor in increased production—here is a subject worthy of more careful study than has yet been given it. The railroads spend vast amounts for new machine tool equipment and it is doubtful if in all cases this money is spent in a manner that assures the greatest return on the investment.

When it comes to the development of mechanics and foremen, who is more directly concerned than the general foreman? In the training and handling of men we have just barely scratched the surface. Changing economic conditions have demanded new methods in industrial relationships and one must keep pace with the changing tide of developments in order to cope successfully with new problems.

The General Foremen's Association has gone far in recognizing the importance of these things, but the big job is ahead. The future of the Association and the scope of its influence will depend largely on the next move. If the members of the organization will but catch a vision of its possibilities and the far reaching influence it can exert they will work untiringly to increase the membership and assist in the preparation of a program for the 1927 convention that will be of such significance that no wide awake mechanical department officer would risk not being represented at its sessions.

What's in a name?

When for twenty-five years a group of men with a common purpose has been working together in an association, the name of that association acquires a significance far beyond a mere description of the group. To the older members it stands for fellowship of the highest order; it recalls memories of struggles and of defeats which were never quite defeats because, through courage and persistence, they were ultimately turned into success; it signifies progress from weakness through opposition to strength and influence. To the younger members it signifies permanence—an established institution in the work of which they are proud to participate. Indeed, the name becomes the emblem of all that has gone into the building of the character of the organization and, as such, is not lightly to be changed.

In the course of its growth, however, the very success with which it has achieved the purposes for which it was organized may open up widening opportunities for service to its industry which may require a broadening of the scope of its work that can most quickly be made known to its field by a more clearly descriptive name. It is then that the overruling of sentiment and tradition is evidence of a sound and forward-looking organization. Such was the case with the Chief Interchange Car Inspectors' and Car Foremen's Association of America when in convention at Chicago, September 21, 22 and 23, it voted to change its name to the Railway Car Department Officers' Association.

This association of interchange inspectors and car foremen was founded in 1901, and the membership has now grown to exceed 1,300 in number. It was particularly fitting that at this convention, which is its silver anniversary, the association should tighten its belt and prepare for still more aggressive work in the interest of the railroads as a whole. The selection of the new name is not designed to change in any way the amount or character of the work done by the former Chief Interchange Car Inspectors' and Car Foremen's Association, but simply to broaden its scope and encourage membership by car department supervisory officers of all ranks.

Comment on this year's convention would be incomplete without special emphasis on the attempt made to secure some practical solution of the present difficult problem of excessive transfers of loaded cars. In the case of loaded cars with transferrable defects not of such a nature as to prevent safe operation of the cars in trains, there was a decided difference of opinion regarding the advisability of the delivering line guaranteeing rebuttal transfer should subsequent transfer of the load prove unavoidable, but the association was practically unanimously in favor of a set of resolutions presented as the solution of the transfer problem by C. J. Nelson, chief interchange inspector, Chicago. These resolutions are printed in full on another page of this issue and it seems apparent that if all railway forces responsible for the maintenance and handling of car equipment can absorb and live up to the spirit of these resolutions, the transfer problem and also a considerable part of the loss and damage problem will be solved to the great financial advantage of railways, shippers and the general public.

A new era of railroading

Not many years ago, one of the tendencies in the railway industry which was disturbing to many observers interested in its welfare was the growth of departmentalism. There seemed to be a strong tendency for the heads of the various departments, particularly the technical departments, to regard with professional jealousy the work of their own departments, with apparently little disposition to acquire a broad vision of the operations of the railroad as a whole. Mechanical department executives seemed prone to carry with them into their executive positions the viewpoint of the shop supervisor and to measure the broad problems of the department by their relations to the shop and roundhouse rather than by their relations to the operation of the railroad as a whole. Operating officers who attained executive positions too frequently were unable to visualize the needs of other departments in their broader relations as operating factors.

This growth of sharply defined departmental compartments in the structure of the railway organization seemed to be the logical outcome of the growth in size of railway properties to a point where some observers were asking themselves whether it was within human capacity for the individual to attain a knowledge and understanding of railway operations as a whole sufficiently comprehensive to break down these departmental walls, without sacrificing his ability to deal with the increasingly complex problems within his own department. A survey of the situation today, however, reveals many evidences that these walls are being lowered, if not completely removed, with surprising rapidity. No attempt will be made at this time to set down all of the factors which may have brought about this change. Were they all to be traced back to their source, however, it is probable that they would be found to spring from the almost limitless capacity of the human intellect when controlled by ambition—not ambition for self-improvement alone, but ambition for the improvement of a great industry.

A striking evidence of this increase in breadth of vision is afforded by the recent convention of the Traveling Engineers' Association. This organization has long been an important factor in the education of traveling engineers in their specific duties of training men in the management and manipulation of the steam locomotive in service. In the recent convention, however,

a full day was given over to a symposium on the steam locomotive, covering motive power design, utilization, maintenance and improvement—subjects embracing the problems of executive, operating and mechanical officers, and most of their supervisors.

This is, perhaps, an outstanding example of association work for which the Traveling Engineers' Association deserves full credit. It is, however, only an example of the character of work which is being done by several associations of supervisors and officers coming wholly or partially within the field of the mechanical department. A study of the proceedings of the recent convention of the International Railway General Foremen's Association, held last month, and of the International Railway Fuel Association convention, held in May of this year, will bear out this statement. All of these conventions bring out strongly the disposition on the part of departmental officers and supervisors to regard their broader problems as not for solution by themselves alone, but as problems of railroading which must be solved co-operatively for the best interests of the organization as a whole.

These officers and supervisors are building sound foundations for the future structures of their respective associations and for the future structure of the transportation industry when they take advantage of the tremendous educational possibilities of their associations to hasten the acquirement of a broad knowledge of their industry as a whole and a sound comprehension of its problems.

Tool standardization proposed

The outstanding feature of the American Railway Tool Foremen's convention, held at Chicago, September 1, 2 and 3, as reported on another page of this issue, was the work on standardization (or perhaps better called "simplification") of small tools used by railroads. While as yet the association has little more than scratched the surface of possibilities along this line, it is apparently proceeding in the right direction. After exhaustive discussion and argument at the 1925 convention, the association agreed on the best general design and construction of a limited number of sizes of locomotive taper frame and rod reamers, the adoption of which will be of substantial benefit to the railways as a whole in a number of ways. This year the association agreed on a much more difficult subject, namely, the general designs of boiler taps, the form of threads, and the number of threads per inch in a limited number of sizes. A standing committee on standardization will report on other tools at subsequent conventions.

The advantages of this work are many. The trouble at the present time is that each railroad has so many different styles of each type of small tool, these styles differing slightly on different railroads, that the manufacturers are greatly handicapped in any attempt to install production methods on any one style and carry it in stock. The railroads accordingly in many cases have to pay relatively high prices for small tools and cannot get prompt deliveries. Another advantage of fewer tool types and sizes on the railroads as a whole will be that manufacturers can then get sufficient production to justify them in making many of the special tools now made by the railroads for themselves at excessive cost and sometimes with inferior quality. By getting together and giving joint consideration to the needs it is unquestionably true that the railroads can substantially reduce the number of types and sizes of small tools to their mutual advantage as well as to that of the manufacturers.

The work of the American Railway Tool Foremen's Association in standardizing small tools was commended by E. W. Ely, assistant director of the National Metals Utilization committee, Department of Commerce, Washington, who in an address on "Simplification" pointed out the tremendous waste in industry as a whole on account of the multitudinous variety of objects manufactured, and explained what has already been done to improve the situation. Within the past few years paving brick has been reduced from 66 varieties to four with an estimated annual saving of $1,000,000. Sheet steel of 1,819 varieties has been reduced to 261 varieties with an estimated annual saving of $2,400,000. A reduction of 60 per cent in lumber varieties has resulted in an estimated saving of $250,000,000 annually. Mr. Ely pointed out that *Simplified Practice* is not *Standardization*, but simply a reduction of the variety of sizes, dimensions and immaterial differences in every day commodities as a means of eliminating waste, decreasing costs and increasing profits, to the ultimate advantage of the manufacturer, dealer and user. To continue the comparison above, files, rasps, milling cutters, chasers for self-opening die heads, grinding wheels and similar material have been simplified, the average reduction in variety being 59 per cent. In grinding wheels alone, for example, 715,-000 varieties have been reduced to 255,800 with an obvious saving to all concerned in the manufacture, distribution and use of this important type of equipment.

The railroads are important users of material of all kinds including tools, and stand in a position to be of great help in the program of waste elimination being fostered by the Department of Commerce. Obviously, if railway ideas regarding tools and equipment can be unified and passed on to the equipment manufacturers the latter will be able to co-operate with the railroads to their mutual advantage. For the maximum benefit it is essential that each railroad adopt a simplification program for small tools coinciding as nearly as practicable with that of other roads. It would appear therefore that this subject is one on which the American Railway Association, Mechanical Division, should take action, doubtless leaning heavily on the advice and recommendations of such associations as that of the tool foremen and shop foremen who in the last analysis are the users of tools and best understand the requirements.

New Books

The Air Brake Association Proceedings, 1926. *Edited by the secretary, F. M. Nellis, 165 Broadway, New York. 350 pages, illustrated, bound in leather. Price* $3.00.

This book contains the proceedings of the thirty-third annual convention of the Air Brake Association which was held at New Orleans, La., May 4, 5, 6 and 7, 1926. The reports and papers submitted were on the subjects of air brake hose coupling gages, retaining valve testing, air brake tests of locomotives and trains in accordance with government laws, triple valve repairs, modern freight train handling, manufacture of wrought iron pipe, recent improvements in passenger train braking, better insulating of steam cylinders for air compressors, brake pipe leakage, threading and bending of air brake pipes for locomotives and cars, manufacture of steel pipe, and recommended practice. The table of contents lists all the reports and papers printed in the proceedings since 1894. This affords an excellent reference for those who have occasion to refer to work of the association during past years.

Survey of employee representation*

The second of a series of discussions of books on improved supervision and better employee relations

NO one man has done more to help develop the fundamental principles of successful management and focus attention upon human relations in industry than Dr. Henry C. Metcalf. In presenting him two years ago as one of the judges in the Railway Age competition for the best articles on co-operation in the interests of greater economy and efficiency on the railroads, this statement was made: He "is characterized by one who knows him well as being 'eminently successful in humanizing economics'; by another, 'as an interesting combination of idealist and practical go-getter when it comes to applying sound principles. He is keen, intense and tremendously stimulating to those with whom he comes in contact and absolutely intellectually honest.'"

Doctor Metcalf early recognized the advisability of having a thorough study made of employee representation. He succeeded in enlisting a number of individuals and concerns in financing the costs of the investigation. The next step was to find a man who could make such a survey under the direction of Doctor Metcalf. Ernest Richmond Burton, who had already made some study of employee representation, was finally induced to make the survey. In the words of Mr. Burton, in the preface to the book which has recently been published: "At every point in the recent investigation Doctor Metcalf has counselled most helpfully and patiently; and through his wide contacts in industry he has facilitated access to important data." Incidentally, Mr. Burton's treatise has a foreword by Dr. Metcalf and the book itself is one of the "human relations series of books" which have been brought out under the editorship of Doctor Metcalf.

While there are several hundred examples of employee representation in industries in this country, it was thought best to pick out a limited number of installations and make a careful first-hand investigation of these, rather than to make a more extensive but less thorough study. This was supplemented by several roundtable conferences, held in various parts of the country, by business executives who have had more or less experience with employee representation.

The report prepared by Mr. Burton proceeds first to build up the right sort of a background for the study and then in the 13 following chapters discusses the needs and purposes of employee representation, the methods of organization and procedure, the administration and finally the results under three headings: (1) terms and conditions of employment, (2) output—efficiency—morale, (3) evaluation. Appendices furnish statistical data relating to certain employee representation plans and also present a selected bibliography.

The discussion of the book in greater detail presents a difficult task because of the thorough way in which the entire subject is treated and the vast amount of information which is included. Doctor Metcalf's foreword is a gem in itself, as is indicated by the two following quotations from it:

"Employee representation is making at least three significant contributions to American industrial life. It is converting industry from a purely productive process, turning out massed material units, into an educational experience for all engaged in its absorbing activities. It is facilitating the realization of a more truly scientific method of management. Through its operation as a means of orderly, industrial governance, it is injecting new meaning and value into that much maligned concept, democracy."

"Employee representation is developing the habit among executives and among the rank and file of weighing human attitudes, of including human desires among the factors entering into the solution of management problems, and of placing them in their proper relation to other elements—material and economic—which must be taken into consideration."

It must, of course, be kept clearly in mind that employee representation is a comparatively recent development in American industry. Few attempts have been made thoroughly to analyze its purposes or to outline its fundamental principles. There has therefore been going on in recent years a great deal of experimentation, depending to a large extent on the personalities of individuals who have been fostering employee representation, and local conditions. It is not surprising to find in Mr. Burton's report, therefore, a wide diversity of ideas and methods concerning employee representation. The outstanding purposes of employee representation from the employer's standpoint, however, as gathered from roundtable discussion on the part of the executives, are as follows:

"(A) Double track channel of communication for exchange of information, opinions and desires.

"(B) Procedure for prompt adjustment of individual and group misunderstandings, complaints and grievances.

"(C) Procedure for collective negotiations (unhampered by external influences or irrelevant issues making for fruitless controversy), regarding wages, hours, and other terms of the employment contract.

"(D) Education of employes. (1) Of the rank and file, to appreciate in some degree the difficulties of the managerial functions not only regarding wages, hours and other matters usually regarded as directly affecting employees, but also with reference to larger policies of finance, production, marketing and public relations. (2) Of persons in supervisory positions who, through serving as management representatives on joint conference committees, may acquire a broader comprehension of managerial responsibilities, particularly those affecting personnel relations."

Naturally in inaugurating a plan of this sort steps must first be taken to educate the supervisors and foremen as to its objectives and to see that they are thoroughly informed and in sympathy with the plan. The detail procedure for launching several plans of this sort is given, as well as suggestions as to the various provisions for amendment and termination of the agreements and the best time at which to introduce employee representation. It is important that the management assume responsibility for the effective operation of the plan and steps must also be taken to assure adequate representation of the employees. These points are clearly developed.

Then follow discussions of joint conference bodies and various details associated with such conferences. After the presentation of the underlying principles governing the essential features of employee representation, follow

*Employee Representation, by Ernest Richmond Burton, supervisor of research, Bureau of Personnel Administration. Published by the Williams & Wilkins Company, Baltimore, Md. Bound in cloth, 283 pages, 8 in. by 5¼ in. Price, $3.00.

several chapters including discussions of some of the more important problems of its operation, and of the need of a periodic audit of progress.

Naturally, special interest will be directed to those parts of the survey which deal with the results of employee representation; three chapters are required for this purpose. The first one on "Results—Terms and Conditions of Employment" includes a discussion of examples of matters negotiated under employee representation, collective negotiations under employee representation, trade union criticisms of employee representation, intimidation of representatives, lack of expert counsel and power under employee representation, demonstrated ability of employee representatives, and do employees need union affiliation. Under the latter head appears this significant statement: "Thus, while the works council or its employee members, if it is a joint body, possess no weapon such as the unions' 'war chest,' a treasury available for financing strikes, need for such defensive armament is less likely to arise, since employee representation promotes a partnership spirit which treats conflict as a constructive force."

In summing up the chapter on the results from the standpoint of output, efficiency and morale, the author makes this statement:

> "We cannot emphasize too strongly, however, that these products of employee representation—greater output, increased efficiency and improved morale—cannot be achieved (1) unless management policies and practices respecting wages and working conditions are as satisfactory as those of competitors in the labor market and have been justified in the minds of employees as the result of frank discussions or negotiations with their representatives; (2) unless the administration and managerial staff is itself efficient and obviously so; and (3) unless the management is ready to discuss frankly with employee representatives actual, tangible problems confronting it, and upon which it genuinely desires employees' advice and co-operation. If these three conditions are established, co-operation of employee representatives will be forthcoming. If the representatives continue faithful to their constituents with respect to the matters of vital interest to them, their prestige will enable them to win for the management the confidence and co-operation of the entire force."

Employers have adopted employee representation for various reasons; in the railroad field, so far as the mechanical department is concerned, primarily because the former conditions were unbearable and it was necessary to find some way of building up the right spirit of co-operation and teamwork and insuring efficient and economical operation of the railroads with continuity of service. As in other industries, it was necessary in taking up this plan to do more or less pioneer work. Some roads have made much progress in building up a strong and substantial organization on this basis. Others may not have been quite so successful, but at the same time have made substantial progress. The point that Mr. Burton makes in his closing chapter on "Results: Evaluation" is that, "Employee representation requires a higher type of management than is necessary without it. Executives and their staffs need not only to be technically 'on their toes,' but to understand more fully and sympathetically the human values involved in industrial operations. But the greater effort and the keener intelligence which employee representation demands is amply rewarded in the morale which it engenders."

The book closes with the significant statement that "the growth of the movement may be slower than in the past, but it is likely to be more permanent than that of the earlier years, since the basic principles which should underlie employee representation have been fairly well indicated by experience of the last decade."

The railways and industries are under deep obligation to Doctor Metcalf and Mr. Burton for this extensive and thorough, scientific study of employee representation. The book is not one which can be picked up lightly and laid aside thoughtlessly. It must be read and studied carefully and critically. It represents in many ways one of the most important contributions that has thus far been made to the analysis and scientific study of industrial management.

Lubrication of steam locomotives

A discussion of the relative merits of oil and grease for lubricating locomotive journals

By Geo. W. Armstrong

GREASE is the commonly accepted means of lubricating locomotive driving journals, although oil is still used for engine truck and trailer axles. Grease does not lubricate except after the journal becomes warm enough to soften it, and clearance is needed between the journal and bearing to permit sufficient movement of the journal to allow the grease to feed. It has a higher frictional resistance than oil. However, lubrication without appreciable heating demands continual application of the lubricating medium. Grease, due to its body or cohesion, is susceptible of being kept in contact with the surface to be lubricated by a spring actuated follower. Oil lubrication in the past has depended upon wool waste with its capillary attraction to conduct the oil up to the surface to be lubricated. The constant shocks received in running tends to pack the wool waste and thus impair its lubricating functions. In fact there are times when the waste will compact to the point where no lubricant is delivered to the bearing at all. The glazing over the surface strands of the packing due to continual contact with the rotating journal will also destroy the capillary attraction of the waste.

Grease has less adhesiveness than oil, and it will not adhere to the surface of the journal sufficiently to become wedged between the journal and the bearing, without sufficient clearance or looseness to permit the grease to be carried up into the bearing by clinging to the journal before the bearing comes in contact with the journal. This is made possible by the backward and forward movement of the journal. This theory is borne out by the fact that it is impossible to lubricate with grease journals other than driving journals subject to reciprocating power transmission. Engine truck journals, trailer journals and electric locomotive driving journals, except jack shaft rod drive locomotives, cannot be grease lubricated.

A system of oil lubrication which will insure a continuous flow of oil would overcome the defects of the wool waste system and combine the advantages of the continuous grease lubricating system with a reduction

in frictional loss, which will be discussed later. Two systems, or rather methods, of oil lubrication other than the common wool waste method are available; namely, force feed and splash feed. Experiments have shown that the capacity of a high speed bearing to carry its load depends upon the fact that the journal never runs concentric with its brass. If lubricant is fed between the two surfaces, the area through which it enters the clearance space between the journal and its brass, being larger than the area through which it escapes on the opposite side of the bearing, a pressure is set up in the film of oil which effectually spearates the metal surfaces. Further experiments by Beauchamp Tower* showed the pressure of the oil at the top of the bearing varied from 310 to 625 lb. per sq. in., the greatest pressure being a little to the "off" side of the center line of the top bearing, in the direction of motion of the journal. This would tend to explain the failure of force feed lubrication to lubricate successfully from the top or side of the bearing.

The splash system of lubrication floods the bottom of the journal with oil. It is now successfully utilized in engine truck lubrication with marked improvement over waste fed lubrication.

Tests were made at Purdue University in 1906 with a 4-4-2 type locomotive having 95,000 lb. weight on the drivers, a total weight of 176,000 lb. 21-in. by 26-in. cylinders, 200 lb. boiler pressure and a tractive force of 24,600 lb., with oil and grease lubrication. These tests were reported by Professor Goss to the Master Mechanics' Association in 1906 as follows:

"The results show that with slow speed the friction of the machinery with grease lubrication is greater when hot than when cold, while at higher speeds results are contradictory, but the differences are in no cases great. The results also show that with oil, the friction under all conditions of running is higher when the machinery is hot than when cold, though in this case the differences are very slight.

"Accepting the oil lubrication as a basis of comparison, it appears that at 20 m.p.h. the loss of power resulting from the use of grease is slight, so small in fact as to be almost negligible, but as the speed is increased and at 60 m.p.h., it amounts to from 140 to 160 hp. The equivalent coal loss, assuming 4 lb. of coal per hp.-hr., is something more than 500 lb. per hour."

The Purdue tests, a summary of which is given in Tables I and II, constitute the only available record of tests to determine the relative efficiency of grease and oil lubrication. However, the St. Louis tests in 1904 covered two Consolidation locomotives of similar dimensions, one of which was oil lubricated, the other grease. An analysis of the test results of these locomotives tends to confirm the observations made at Purdue.

The test results shown in Table III substantiate the theoretical conclusion that friction developed with grease lubrication will be greater than oil for two reasons; first, when grease is cold, its cohesion is greater than oil and its adhesion to the bearing surfaces is less and consequently the coefficient of friction is higher, and second, when grease is in a fluid or semi-fluid state, its cohesion while less than in the solid condition, is still greater than oil. Its adhesion to the bearing surfaces, while greater than in the solid state, is, however, less than oil, and consequently the coefficient of friction is higher.

The expenditure of greater frictional energy is evidenced by the greater heating of a journal grease lubricated, which heat is required to reduce the solid grease to a fluid state.

Due to the increased friction of grease over oil lubrication, greater clearance in the driving box frame journal assembly must be allowed to take care of expansion, where an engine is grease lubricated. This is reflected in the amount that a wedge is pulled down after being set up tight, when the machinery is cold. A wedge that must be pulled back 1/8 in. with oil-lubricated journals would need to be pulled down 3/8 in. grease lubricated.

Table I—Summary of Purdue test results, showing the pounds pull at the drawbar necessary to overcome friction of the locomotive with oil and grease

Speed of locomotive	20 m.p.h.		50 m.p.h.		60 m.p.h.	
	Grease	Oil	Grease	Oil	Grease	Oil
Cold start	1,578	1,435	1,862	555	1,727	655
Hot start	2,222	1,549	1.628	780	1,804	873
Average	1,900	1,492	1,745	667	1,765	764
Tractive force lost by use of grease	408		1,078		1,001	
Horsepower	21.8		143.7		160.2	
Coal lost per hour run (assuming 4 lb. per hp. hr.)	87.2		574.8		640.8	

What does this mean in practical operation? Before answering, a brief review must be taken of the laws of friction of well lubricated journals.

1—Frictional resistance, all other conditions remaining constant, increases directly with the pressure between the masses in contact.

2—The Frictional resistance is directly proportional to the area of rubbing surface, the normal pressure remaining constant.

Table II—Relative machine efficiency for oil and grease

Test	No. tests	Drawbar pull Equiv. I.hp.	Drawbar pull Equiv. Aver. obs.	Friction loss	Machine efficiency
OIL					
Engine cold, 20 m.p.h.	7	9,088	7,651	1,435	84.3
Engine hot, 20 m.p.h.	21	9,157	7,609	1,549	83.2
Engine cold, 50 m.p.h.	5	5,326	4,772	554	89.8
Engine hot, 50 m.p.h.	18	5,593	4,813	780	86.3
Engine cold, 60 m.p.h.	11	5,114	4.459	655	87.3
Engine hot, 60 m.p.h.	20	5,061	4,188	873	82.7
GREASE					
Engine cold, 20 m.p.h.	35	9,061	7,482	1,578	82.5
Engine hot, 20 m.p.h.	52	9,981	7,758	2.222	77.8
Engine cold. 50 m.p.h.	16	5.302	3,441	1.862	64.9
Engine hot, 50 m.p.h.	9	5.332	3,704	1,628	69.6
Engine cold, 60 m.p.h.	9	5,023	3,295	1,727	65.5
Engine hot, 60 m.p.h.	9	4,948	3,144	1,804	63.6

3—The coefficient of friction at very low journal speeds is abnormally high; but as the speed of sliding increases from about 10 to 100 ft. per min., the friction diminishes, and again rises when that speed is exceeded, varying approximately as the square root of the speed.

4—The coefficient of friction, other conditions remaining constant, varies approximately inversely as the temperature, within certain limits, i. e., just before abrasion takes place. (The Purdue tests, however, showed an increase in temperature.)

5—Frictional resistance is proportional to the density of the fluid, but related in some way to its viscosity.

The laws of friction given above state that resistance due to friction varies directly with the pressure between the masses in contact, and is directly proportional to the area of rubbing surface, or what amounts to the same thing, the projected area of the bearing—the journal diameter times the length. The journal size bears a fixed relation to the driving wheel load, consequently the frictional loss will vary directly with the load. Assuming that this is so, the same percentage loss will be developed with grease lubrication due to the increased friction, in a modern locomotive as in those tested in 1904 and 1906.

As a result of the observed difference in machine efficiency of various oil and grease lubricated locomotives in the St. Louis tests, the following statement was made: "It appears from an inspection of the plotted data that the use of grease may be expected to increase the friction losses per journal by from 75 to over 100 per cent." This observation would seem to be warranted by an examination of the chart prepared from the Purdue tests

* See January, 1885, proceedings of the Institute of Mechanical Engineers, London, England.

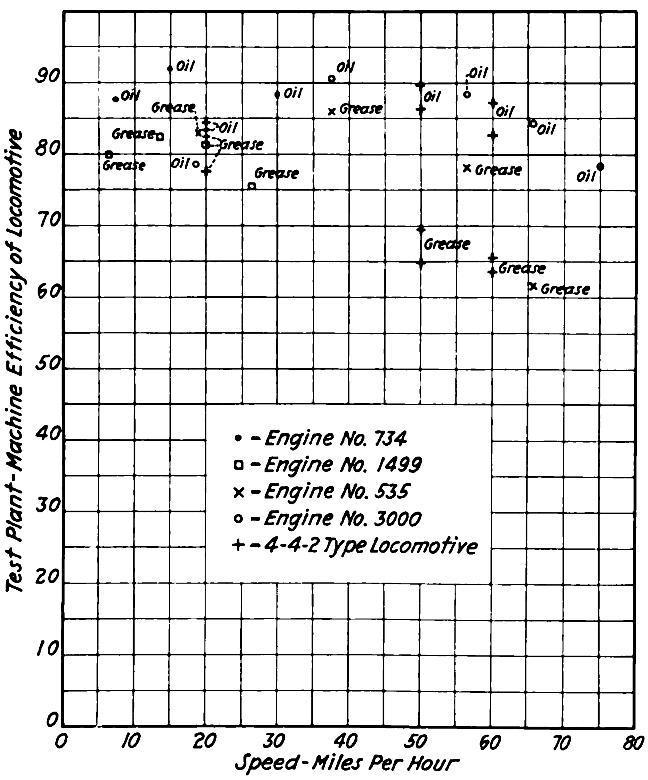
and those of locomotives 1499 and 734 in the St. Louis tests. It would appear that under good oil lubrication the loss varied from 10 to 15 per cent, while with grease lubrication the loss varied from 18 to 30 per cent.

In addition to the locomotives previously covered in this discussion there is plotted on the chart the machine efficiencies of locomotives No. 3,000 and No. 535, four-cylinder balanced 4-4-2 type locomotives of the New York Central and Atchison, Topeka & Santa Fe, respectively, which were also tested on the St. Louis plant in 1904. It must be remembered that the relative machine efficiencies of locomotives tested on a test plant as these were, reflect the relative frictional resistances of oil and grease lubrication, as the driving journal friction represents the major portion of the loss between the cylinder developed power and the observed drawbar pull. The machine efficiencies in road operation will be lower than those observed in test plant operation, inasmuch as they include not only the frictional resistances recorded on the test plant, but that required to move the engine and tender. However, approximately the same difference will exist between oil and grease lubrication and that difference will be lost and must be paid for by additional coal consumption, if the locomotive is grease lubricated, or can be utilized for useful work if the locomotive is oil lubricated.

Table III—Summary of St. Louis tests, 1904

	Penn. Eng. No. 1499	L. S. & M. S. Eng. No. 734
Method of lubrication	Grease	Oil
Tractive force	42,168 lb.	35,800 lb
Weight of drivers	173,200 lb.	162,600 lb.
Diameter of drivers	56 in.	63 in
Cylinders, diameter and stroke	22 in. by 28 in.	21 in. by 30 in.

Speed m.p.h.	No. tests	Drawbar pull: Equiv. i.hp.	Drawbar pull: Aver. obs.	Friction loss	Machine efficiency
Engine No. 734 (Oil)					
7.5	3	21,257	18,638	2.619	87.6
15.0	3	18,908	17,391	1,516	92.1
30.0	6	11,736	10,388	1,348	88.6
Engine No. 1499 (Grease)					
6.7	2	22,921	18,285	4,644	79.9
13.5	4	20,035	16,452	3,591	82.1
20.0	2	18,853	15,348	3,511	81.6
26.7	4	12,824	9,654	3,171	75.3



Comparative machine efficiencies of locomotives with oil and grease lubrication—Data from St. Louis and Purdue tests

The indicated horsepower, theoretical tractive force and machine friction based on an eight per cent increase in grease over oil lubrication have been figured at various speeds for typical 4-6-2 and 2-8-2 type locomotives, being arranged in Table IV. The essential dimensions of these locomotives are as follows:

	4-6-2 type	2-8-2 type
Cylinders, diam. and stroke	27 in. by 28 in.	28 in. by 32 in.
Diameter drivers	80 in.	63 in.
Boiler pressure	205	200
Tractive force	44,460 lb.	67,700 lb.

A 2-8-2 type of good design can operate on about 3 lb. of coal per i.hp. hour, while a 4-6-2 locomotive will average 2.5 lb. up to about 50 miles per hour, increasing above that point so that 3 lb. per i.hp. hour will not truly reflect conditions. The increased coal consumption, see Table IV, represents conservatively the amount required per hour to compensate for the greater frictional resistance of grease lubrication.

In concluding his report on oil vs. grease lubrication in 1906, Professor Goss said: "1,000 lb. at the drawbar, when the locomotive is developing 30,000 to 40,000 lb., is a very small percentage and it is for that reason that at slow speeds the power equivalent is small, but as the speed becomes high and the maximum drawbar force, which the locomotive can develop is reduced to 6,000 or 7,000 lb., then the 1,000 lb. absorbed by the grease friction in excess of that required by oil becomes relatively large."

Table IV—Theoretical tractive force and machine friction at various speeds for 2-8-2 and 4-6-2 type locomotives

Speed m.p.h.	I.hp.	Tractive force	Machine friction based on 8 per cent inc. grease over oil: I.hp.	Machine friction: Drawbar pull	Equiv. increased coal due to excess grease friction: At 3 lb. I.hp. hr.	At 2.5 lb. per I.hp. hr.
2-8-2						
10	1,750	65,330	140	3,920	420	...
15	2,254	56,870	180	4,550	540	...
20	2,559	47,390	205	3,790	615	...
25	2,691	40,620	215	3,250	645	...
4-6-2						
20	2,117	38,365	169	3,070	...	423
25	2,327	35,400	186	2,830	...	465
30	2,461	30,810	197	2,465	...	493
40	2,615	25,075	209	2,005	...	523
50	2,690	20,185	215	1,615	675	...
60	2,690	16,850	215	1,350	675	...

The importance of decreased frictional resistance is greatest with passenger locomotives, as pointed out by Professor Goss, owing to the small reserve at high speeds, but it is also well worth study in its reduction as applied to heavy freight power, especially so in view of the trend at the present time from slow speed drag service to moderate and high speed capacity service. The one essential required to assure the benefits of decreased frictional loss, the attainment of greater locomotive machine efficiency is a reliable, dependable, simple and economical method of oil journal lubrication.

2-6-0 locomotive on the Dayton & Michigan in 1882—Cylinders 18 in. by 24 in., 56-in. drivers

What is the locomotive of today?

T.E.A. conducts symposium of builders and railroad officers, who discuss present motive power status and probable future developments

THE second day of the Traveling Engineers' Association convention, held at Chicago, September 14 to 17, was devoted to a symposium on the locomotive of today, in which a group of railway operating and mechanical officers and engineering representatives of the builders participated. The result was a comprehensive review of the best in modern steam locomotive development, a clear interpretation of the possibilities offered by recent developments in locomotive design and proportions, a thorough discussion of the possibilities of more effective utilization of locomotives, and a well-considered estimate of developments which may be expected in the near future. Samuel O. Dunn, editor of the Railway Age, presided and introduced the speakers, who were A. R. Ayers, assistant general manager, N. Y. C. & St. L.; O. S. Jackson, superintendent motive power and machinery, U. P.; W. E. Woodard, vice-president, Lima Locomotive Works; J. B. Ennis, vice-president, American Locomotive Company; W. L. Bean, mechanical manager, N. Y. N. H. & H.; A. G. Trumbull, chief mechanical engineer, Erie; C. T. Ripley, chief mechanical engineer, A. T. & S. F., and J. E. Muhfeld. Abstracts of the addresses by Messrs. Ayers (which was read by W. G. Black, superintendent of motive power, N. Y. C. & St. L.), Jackson, Woodard and Ennis are included in this issue. Those of the other speakers will appear next month.

In his opening address, Mr. Dunn laid in the background of the picture against which the other speakers brought out in sharper outline the many specific features of locomotive design and operation which give the locomotive of today its outstanding characteristics.

After recording some of the outstanding increases in weight and tractive force of the locomotive which have taken place during a period of 20 years, Mr. Dunn gave a more comprehensive picture of the developments of this period by presenting changes in the number of locomotives and in the average tractive force which have taken place. "On June 30, 1916," he said, "the Class I railways had approximately 48,055 locomotives. Between that date and June 30, 1916, they retired 15,570, or about 32 per cent of the total number, and installed 29,393 new locomotives. On June 30, 1916, they had 61,057 locomotives, and between that date and December 31, 1925, they retired 17,853, or 28 per cent of the total number, and installed 20,452 locomotives, which increased the total number to 63,656. The total retirements during this period of almost 20 years were 33,423, or 69 per cent of the number owned on June 30, 1906, while the number installed in service was 49,845, or 77 per cent of the total number owned on December 31, 1925. It would appear from the foregoing figures that about 32 per cent of the locomotives now in service are less than ten years old, and that about 78 per cent are less than 20 years old.

"In this constant process of retirements and installations, the average tractive force of locomotives has steadily increased. In 1906 it was 24,741 lb. for all the locomotives owned by the railways, and in 1916 it was 32,423 lb., an increase of 31 per cent. For the year 1925 we have only the statistics of Class I roads. The average tractive force of their locomotives in 1916 was 33,181 lb., and in 1925, 40,719 lb., an increase of 23 per cent. The increase in the average tractive force per locomotive during the entire period of 20 years was about 65 per cent. In other words, at the beginning of this period of 20 years, five average locomotives had theoretically only as much pulling power as three average locomotives had at the end of it."

Mr. Dunn then took up the question of the average performance which these changes had effected, using the number of gross-tons hauled one mile per train-hour as the best measure of performance. Dividing the period from 1906 into two decades and basing his comparisons on estimates of train speed in 1906 and 1916, Mr. Dunn continued: "It would appear that gross tons per train averaged in 1906 about 881 tons and in 1916 about 1,249 tons. This was a period during which the railways put forth great efforts to effect economies by increasing the average load of freight trains but did little to increase their average speed. It seems reasonable, therefore, to assume that in both 1906 and 1916 the average speed of freight trains was 10 miles. On that assumption the increase in average gross ton-miles per train hour between these years was about 42 per cent. The increase in the gross train load between 1916 and 1925 was from about 1,249 tons to 1,670 tons, or 34 per cent. The increase during this period in the efficiency with which locomotives were utilized in road service cannot, however, be measured merely by the increase in the average train load. Since the passage of the Adamson Act, and especially since the application of punitive overtime in train service, the railways have made great efforts to increase the average speed of trains, and it was increased from about 10 miles an hour in 1916 to 11.8 miles an hour in 1925. The result of the increases in the average train load and in average speed was an increase in gross ton-miles per train hour from about 12,490 in 1916 to 19,679 in 1925, or 57 per cent.

"These estimated increases of 42 per cent between 1906 and 1916, and of 57 per cent between 1916 and 1925 in gross ton-miles per train hour are, of course, attributable, first, to improvements in locomotives and increases in their tractive power, and second, to improvements in other railway physical facilities and in operating methods resulting in better locomotive utilization.

"Gross ton-miles per train hour have continued to increase this year, having in the first six months of 1926 averaged 20,196, or 5 per cent more than in the first half of 1925, and 62 per cent more than ten years ago."

In commenting on this performance, Mr. Dunn called attention to the fact that only one-third of the locomotives now in service have been installed during the last ten years, and only about 18 per cent of them have been installed since 1920. In this result he said that the designers and builders of locomotives and locomotive specialties on the one hand, and those who operate them on the railroads had participated with a generous ri-

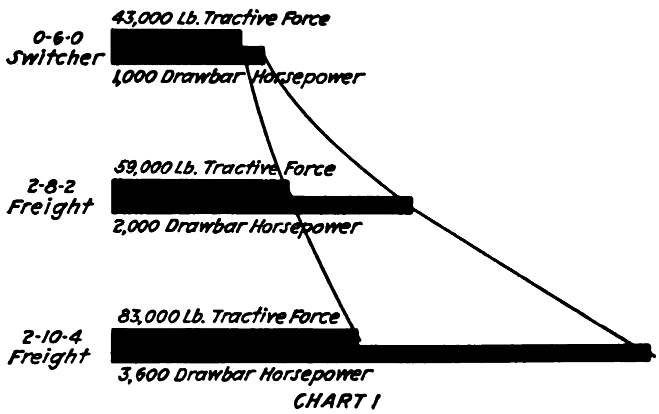
valry, and in concluding he said: "It seems not visionary to express the belief, in view of past experience and especially that of recent years, that old locomotives may in the future be more rapidly replaced with the 'locomotive of today' and that methods of locomotive utilization may be still further improved, with the result of effecting in future much greater proportionate increases in efficiency of operation and improvements of service than even those that have been accomplished during the last five years."

High horsepower output cuts operating costs

By W. E. Woodard

Vice-president, Lima Locomotive Works, Inc., New York City

Gross ton-miles per train hour gives a more reliable index than any other single figure as to the rate at which railways are moving tonnage. It may be regarded as an index of the extent to which railways are utilizing their transportation plants. The railways of the country from 1922 to 1925 increased this figure 21.6 per cent and, what is even more significant, they did this with only a 7.6 per cent increase in total locomotive tractive force. This, truly, was a remarkable achievement and the members of this association in no small measure helped in the accomplishment.



Comparison of locomotives of different classes

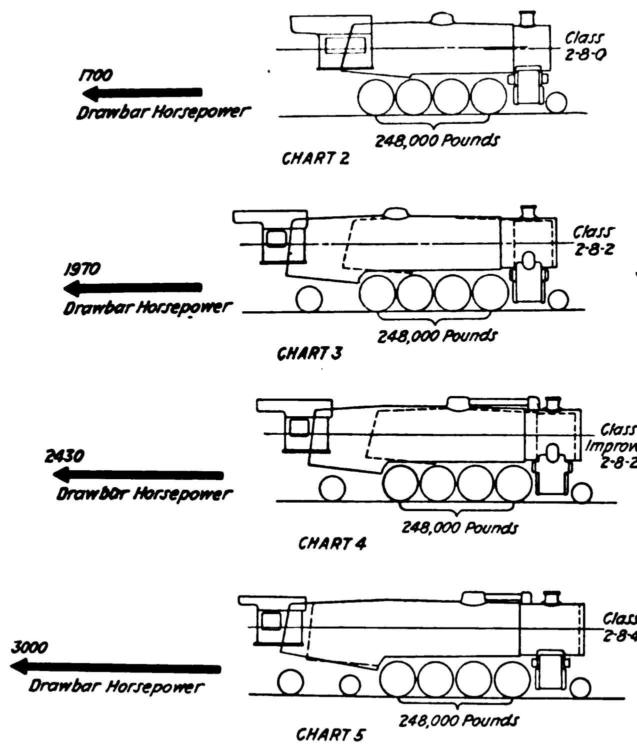
To the locomotive designer and builder this splendid record is significant because it shows that power output is becoming more and more a requirement in fitting locomotive designs into railway companies' needs. While improvements such as better signalling, improved siding and yard facilities, as well as an increase in average car capacity, unquestionably provided some of the means whereby this increase was secured, the fact remains that it could only have been accomplished by a marked increase in the average drawbar horsepower output of the locomotives.

An example from a recent road test will illustrate how tonnage and speed affect this figure: a 2-8-2 locomotive handled 1691 tons in 46 cars over about 46 miles, much of it 1 per cent up-grade, at an average speed of 14¼ miles per hour. In doing this the engine developed an average drawbar horsepower of 1150. On the same day, over the same division, a 2-8-4 locomotive handled 2296 tons in 54 cars, at an average speed of 19.9 miles per hour. The average drawbar horsepower shown on the dynamometer car was 1784. The data is absolutely comparative, because the runs were made on the same day under the same weather conditions. The heavier train at the higher speed required 55 per cent more drawbar horsepower output. These figures are mentioned simply to illustrate what the demand for increased tonnage at higher speed means in terms of power output of the locomotive. These greater requirements often mean the use of a motive power unit of a different class in order to meet the traffic conditions without a sacrifice in tonnage.

In the study of this situation, there is one element which is of special interest, namely, the allowable driving-wheel loads. For the past few years the maximum allowable driver-wheel weight has not been increased, and there is no indication that it will be materially increased in the near future. Therefore, any improvement in the locomotive must come through a more intensive production of power per unit of weight.

In considering the present-day locomotive as a "moving power plant"—which it really is, we can omit from the discussion reference to variations in detail design and focus attention on the fundamental problem, which is—How can we obtain the increased drawbar horsepower which future traffic conditions will demand within existing driver-wheel weights, always keeping in mind locomotive fuel efficiency?

In order that we may get clearly in mind the meaning of the term "drawbar horsepower," I would like to point out the difference between horsepower and tractive force. Tractive force is the pull exerted by the cylinders at the rim of the driving wheels. If we substract from tractive force the pull required to move the engine and tender, we get drawbar pull. Drawbar horsepower is the rate at which drawbar pull is produced. For example (see Chart 1), a heavy six-wheel switcher having a tractive force of 43,000 lb. can produce 33,000 drawbar



Steps in locomotive development over several years

pull at 1000 ft. per min., or 11.2 miles per hour. This equals exactly 1000 drawbar horsepower. An average freight engine having a tractive force of 59,000 lb. will produce 33,000 drawbar pull at 2000 ft. per min., 22.6 miles per hour. This is 2000 drawbar horsepower. One of our biggest freight units having a tractive force of 83,000 lb. can produce 33,000 drawbar pull at 3600 ft. per min., or 41 miles per hour. This is 3600 drawbar

horsepower. Note that the big freight engine will produce 3.6 times as much drawbar horsepower as the switcher, whereas the maximum tractive force of the big engine is less than two times as much as the switcher. The big freight unit will produce almost twice the drawbar horsepower of the average freight engine, whereas its maximum tractive force is only 1.4 times as much.

While this comparison is made between locomotives of different classes, in order to bring out clearly the relation between tractive force and drawbar horsepower, the same thing is true to a lesser degree between locomotives of the same class. Maximum tractive force is no longer an index of the capacity of a locomotive to pull tonnage over a railroad. This statement is confirmed by operating results. From 1922 to 1925 the per cent of increase in gross ton miles per train hour (21.6 per cent) was almost three times the per cent of increase in the total tractive force of the locomotives (7.6 per cent). Beyond question one large element in this result was the more extensive use of modern motive power units in which the proportion of horsepower output to tractive force is far greater than in the older types of engines. If we wish, therefore, to find the value of a locomotive design for producing gross ton miles per hour, major consideration must be given to its drawbar horsepower.

I do not want to give the impression that we have discovered anything new when we talk about increasing the drawbar horsepower output of a locomotive. However, we now realize more clearly the importance of this factor in relation to railway operation, and it is only in recent designs that we have made a deliberate effort to improve this factor by changing some of the relations which existed in locomotive designs of the past.

Up until a short time ago any increase in locomotive power capacity was secured by the use of well-known and existing combinations. How these steps progressed over a number of years past the following charts will show. Chart 2 shows a Consolidation locomotive of about 62,000 lb. per pair of driving wheels and its power output at 25 miles per hour. This general type of locomotive for a number of years was the standard freight unit of the country. As the traffic demands became greater, the same driving-wheel arrangement was used and the additional power secured by the application of a large boiler and trailing truck wheels, with the result that the well-known Mikado type was developed. This type of locomotive and its power output is shown on Chart 3, on the same driving wheel arrangement and load as the Consolidation. The response to the urge for more and more power was a design of the same general type, but with added steam generating capacity in the boiler, resulting from the use of type "E" superheater, feedwater heater, and other refinements of design. This power unit is shown on Chart 4, which is again superimposed upon the same driving wheel arrangement and driving wheel weight as the Consolidation. The last step consisted almost entirely of added boiler capacity and it practically exhausted the possibilities of using the well-known and existing elements of locomotive design for securing maximum power output on a given arrangement of driving wheels and a given driver-wheel weight.

The next step, and one which represents a number of locomotives now in use and being built, was to get more cylinder power into the same driver-wheel weight and furnish means in the boiler for supplying steam for this added cylinder power. This problem has been approached from two different angles by different builders. One method—which is now represented by 105 locomotives in use or building—is to increase the cylinder power by limiting the cut-off and raising the boiler pressure. This has the effect of keeping the maximum tractive force at about the same point or slightly higher than the older designs, but raises the drawbar horsepower at operating speeds in proportion to the increase in pressure. Such a design is shown on Chart 5, again superimposed upon the same driver-wheel arrangement and weight as the old Consolidation.

Added cylinder power output also can be secured by the use of three cylinders with a boiler of sufficient size to supply the cylinder requirements. The result is a similar increase in drawbar horsepower output.

In these comparisons the part played by the boiler in increasing the power output is very apparent, and it is only through higher boiler capacity that cylinder power output can be increased. To the locomotive designer the problem of securing greater capacity in the cylinders is relatively easy; the real problem is to get boiler capacity to supply the increased cylinder requirements.

In this comparison of the four locomotives all upon the same driver-wheel arrangement and driver-wheel weight, I have used actual locomotives and eliminated the variable of driving-wheel load and arrangement, thus making the diagrams comparable. Most of the data is from actual dynamometer car tests and such few figures as have been calculated are based upon actual data, so that the power output is what has been and what is actually being obtained in service at 25 miles per hour.

From the Consolidation, the standard locomotive of a few years ago, to the modern 2-8-4, power output has been increased 76½ per cent without altering driver-wheel arrangement and weight. Here is one of the reasons why the railways could make the showing they did in gross-ton-miles-per-train-hour output from 1922 to 1925. How much improvement is still possible can be gathered from the number of older and smaller locomotives still in use. Of the locomotives assigned to freight service in 1925, about 40 per cent were Consolidations, almost all of them less powerful than the Consolidation I have shown in the diagram; 22½ per cent of all the freight power in 1925 were of the Mikado type, many of them not as powerful as the Mikado I have shown. With all due allowance for the needs of branch-line and pick-up service, these figures reveal the possibility of savings in operation by the substitution of new and improved motive power units.

The comparison has been made upon freight power, as the advance could be more easily traced in the classes of locomotives used in this service. The same principles of increase in power output are applicable to passenger locomotives, but in this line we do not seem to be as far advanced as we are in the locomotive for freight service.

I have confined myself to this rather elementary talk on locomotive power output because of the following reasons, which are a summary of what I have said:

A study of traffic figures clearly reveals a strong trend toward more tonnage at higher speeds; this means more gross ton mile output per train hour, which results in increased demands for power output from the locomotive units.

The allowable driving-wheel loads have remained and probably will remain about stationary. Logically, therefore, the line of progress is to get the greatest amount of power obtainable out of the existing driver-wheel loads.

The diagrams show what already has been done. "The Locomotive of Today" is being made to fit the operating conditions now being developed on the rail-

ways and such a locomotive can briefly be described as follows:

For a freight unit of 60,000 lb. axle load, a locomotive which will develop from 3,000 to 3,600 drawbar horsepower with a boiler of sufficient size to generate steam for this output at combustion rates of not over 100 lb. of coal per square foot of grate per hour. For lighter axle loads, a drawbar horsepower output in proportion to the allowable wheel loads, the maximum combustion rate remaining at 100 lb. of coal per square foot of grate.

This sounds simple. There are a few locomotives running which meet these requirements. This specification stands for the best freight units of the present day.

Reliability, high horsepower and economy

By J. B. Ennis

Vice-president, American Locomotive Company, New York

We have at the present time, three distinct classes of locomotives, steam, electric and internal combustion. Since the advent of railroading in this country, the steam locomotive has been predominant, and still continues to be. While you men are primarily interested in the steam locomotive, it is needless to deny the advantages of any one of the three classes mentioned.

Within the past 25 years, the development of the electric locomotive in this country has progressed steadily and still, more recently, the internal combustion locomotive has entered the field and promises to remain with us. Certain conditions favor for safe and profitable operation the electric locomotive. Still others can be more advantageously met by the oil locomotive.

The electrification of a railroad division means an enormous investment as compared with steam operation which cannot be justified unless there are peculiar conditions particularly favorable to this method of transportation. Even then, the probable economies should be thoroughly investigated to make sure that the financial return will not be in doubt. Careful consideration should also be given to the possibilities of economizing and obtaining greater capacity by the use of improved steam locomotives where the investment would not be so great and the results can be forecast with reasonable accuracy. Unfortunately, comparisons have been made to prove the superior economy of electrification where they have been based upon steam operation with locomotives of old design, and in many cases, very light power. The modern steam locomotive has shown such an improvement in productive capacity and economy, even over locomotives of ten or fifteen years ago, as to warrant its continued use for many years to come for the general service of our railroads.

There are many difficulties in the way of providing an internal combustion locomotive to replace the modern high powered steam locomotive, although, ultimately, the problem will be solved if there is sufficient demand, and if it appears to be an economical necessity. Until this is done, large power in this class can only be obtained by the coupling together of two or more smaller units, and the use of multiple control, which is entirely feasible. Our experience so far with this class of power has been confined to comparatively small units, mostly for switching service. Locomotives are now being built for branch line service of somewhat higher power and designs are being prepared for still larger units.

All of the oil locomotives so far built in this country for railroad operation have been constructed with electric transmission. Experiments are being made, both here and abroad, with other forms of transmission, such as hydraulic and mechanical, and the question of the most satisfactory drive is only one of the many problems yet to be solved. The great advantage of such a locomotive lies in the economy of fuel, the elimination of the boiler with its maintenance troubles, and the possibility of almost continuous daily use.

Thirty years' growth in capacity

Coming now to the steam locomotive, I would like to read a paragraph from the proceedings of the Western Railway Club of March, 1894:

"The most encouraging thing, I think, that we have in the matter of compound locomotives, is the report from the Pennsylvania road, where they show at 70 miles per hour they have developed 914 horsepower. . . . . It is the greatest horsepower, I think, that has ever been reported at such a high speed."

That evidently represented a maximum locomotive of that time from the standpoint of horsepower. A few years later, in 1906, the statement was made at one of our Eastern railroad clubs by an earnest advocate of electric traction that electric locomotives then in service had developed a horsepower at the wheels of 2,500 to 3,000, something that never could be accomplished by the steam locomotive. Today, we have clearances very little in excess of those of thirty years ago, and yet our steam locomotive is a machine that develops more than 3,500 indicated horsepower. In fact, one of our largest freight road locomotives recently built developed in excess of 4,700 indicated horsepower.

We have reached 96,600 lb. tractive force in a simple locomotive of the three-cylinder 4-12-2 type, giving a maximum horsepower of 4,750, and yet have been able to keep bridge and track stresses as low as in the case of smaller and less powerful machines operating in similar service.

Horsepower vs. tractive force

Several years ago, we were too apt to measure a locomotive in terms of tractive force only. The result was under-boilered locomotives, or locomotives that were too slippery to fully utilize the power. Today, we concern ourselves more as to sustained power or the ability to take heavy tonnage trains and keep them going at a good rate of speed. In other words, to produce more gross ton miles per train hour. If you will compare the results obtained in recent months with those of a few years ago in this respect, you will find a much greater increase in output of this character than the mere increase in tractive force would indicate.

As an example, I might mention the case of one of our eastern railroads on which a new design of freight locomotive was developed in which the weight on drivers was increased about 13 per cent. The maximum tractive force was increased 23 per cent and the application of a booster further increased this. A comparison with previous performances of the older engines on a division approximately 140 miles in length shows that the average train load for a larger number of consecutive runs increased 29 per cent and that the average increase in gross ton miles per train hour was 78 per cent. In other words, for a 13 per cent increase in weight on drivers an increase of 78 per cent was obtained in the productive capacity of the locomotive. Even this statement does not really indicate the full advantage obtained as the locomotive mileage per month in this service has reached figures never before realized.

Recent fundamental improvements

Among the fundamental improvements recently made in this country in the steam locomotive through the co-

operation of the motive power officers of the roads and builders might be mentioned the following:

Application of three cylinders, both simple and compound.
High boiler pressure now reaching 400 lb. per sq. in.
Limited cut-off.
Higher temperature superheaters.
Water tube fireboxes.
Large tenders.
Twelve coupled locomotives.
Improvements in details tending to give greater reliability with less maintenance.
Improvements in counterbalance and other conditions making for lower rail stresses.

As builders, we have been constantly aiming to advance the art. Each builder has his own ideas as to the particular characteristics of design that will best fit certain conditions and provide the most efficient machine. Each one has demonstrated under certain conditions that his theories were correct. Each builder is trying to put out the best that he knows how from a designing and construction standpoint, in order to provide the maximum of efficiency, economy and serviceability.

The builders have, in a few cases, brought out for experimental purposes single locomotives designed with the thought of providing increased sustained power, greater economy in fuel, and greater reliability in service. These have demonstrated the possibilities of reducing operating costs through the replacement of obsolete and inefficient power.

A little more than three years ago, we were confronted with the problem of providing, in a given case, considerably more power within certain restricted clearances and weights than had been previously possible. At that time, there seemed to be only one way out of the difficulty and that was the introduction of a third cylinder. There were many obstacles in the way, but we felt that the trouble heretofore experienced with this class of locomotive could be overcome. The first application was on an existing locomotive, and while the cylinders were made 3 in. smaller in diameter than in the case of the two-cylinder engine the maximum tractive force of the engine was increased from 54,000 to 64,500 lb. The same size boiler and firebox were utilized, and in order to provide for better steaming qualities and higher superheat a new design of superheater was installed.

Since the completion of this first locomotive, we have furnished a total of 141 locomotives of the three-cylinder type. A considerably larger number are in successful service abroad. The performance of these locomotives has proved to our satisfaction that in general for the same weight on drivers, an increased hauling capacity can be obtained, varying from 11 to 20 per cent. The advantages, other than the increased power, are better balancing, better steaming of the boiler due to six exhausts instead of four, lower piston thrusts, fuel economy, and better effect on track. The maintenance costs, so far, do not indicate any appreciable higher amounts than those of corresponding two cylinder engines.

Thermal efficiency must be improved

The steam locomotive must be improved from the standpoint of thermal efficiency, in order to remain as it is at present—predominant in its field. Even though most of the locomotives now in service in this country are of the two-cylinder single expansion type, this does not mean that the steam locomotive of the future must be of that type. The fact that many years ago we tried compounding, and discarded it because of its complications, does not necessarily mean that we must be content with single expansion for the future. As a matter of fact, most of the fuel saving devices in use today were tried many years ago and many were discarded because the fuel economy realized at that time did not warrant the expense of arranging for systematic maintenance. This condition is different today. The high cost of fuel has made it of the utmost importance to devise some more efficient method of producing and utilizing steam for power purposes.

This has been particularly true abroad. Probably the most outstanding developments in Europe have been the use quite recently of high pressures, going up to 840 lb. per square inch, and the use of turbine condensing engines with moderately high pressure. Other features now being tried are uniflow cylinders, improved valve gears and poppet valves. Out of this experimental work will, undoubtedly, come some one or more successful fuel-saving systems that will not subtract from the general reliability of the locomotive and its fitness for continuous service, nor will it add materially to the maintenance cost.

In this country, we are reaching for higher pressure. We have built one locomotive having 350 lb. pressure for the Delaware & Hudson, and are building another which will have 400 lb. pressure. The one in service has shown very satisfactory fuel records and, so far, without any excessive maintenance cost. It is of the two-cylinder cross compound type with water tube firebox. We must look to the very high pressure boiler as a source of economy in fuel, and, undoubtedly, great strides will be made in this direction in the near future. Other methods of steam utilization may come with it in order to obtain greater economy.

While we are always striving for better things, we need not be ashamed of coal records from existing steam locomotives showing better than 2 lb. per indicated horsepower-hours and steam records of better than 16 lb. per indicated horsepower-hour. These are the results of refinement in design, of improved material, and better construction, and yet with all of this refinement we do not need to find excessive complications and high maintenance. We have freight locomotives today giving better than 9,000 miles per month in regular service and passenger locomotives giving still more.

Other things needing improvement

Features of lubrication are now being well looked after on our locomotives better than ever before. We must realize a machine of great power operating under the conditions that exist on the railroads of today must be well lubricated in order to remain in motion. Too little attention has been given to this in the past and there is yet a great opportunity for improvement in this particular field.

Some advance has been made in the use of better materials for locomotive details. And, yet, there is probably no one item that will need more attention than this, in the future. We have had entirely too many failures of important locomotive forgings, taking out of service locomotives that otherwise could have been utilized. While we must have materials that will give us minimum weight, still more important is the material that will last until worn down to the safe limit.

In slow speed service where the demands on the boiler are not great, a locomotive having a high percentage of weight on drivers, such as the Consolidation type, has worked out very satisfactorily. Where speed is an important consideration, combined with high sustained drawbar pull, greater boiler capacity is required, and we often find it impossible to obtain this within the allowable limits of driving wheel weights without resorting to trailer trucks. The quality of fuel determines the amount of grate area. No fixed standards can be ap-

plied. Large grate areas are essential in some cases to insure economical rates of combustion. Standby losses must be considered, however.

The steam locomotive is still handicapped to a large extent by too much back pressure caused, in some cases, by too small boilers or fireboxes, and also due to other factors. In order to improve this condition, experiments have been made with fan draft and while, so far, the results obtained have not warranted any general adoption of this method of producing draft, there is ample field for development work in this direction with promise of satisfactory results.

More attention than ever is being given in the design of locomotives to the convenience and safety of cab fittings and the comfort of the engine crew. The importance of this is fully realized, especially on large power, and recent reports from enginemen indicate that this is being accomplished in a satisfactory manner.

The steam locomotive of tomorrow

What of the steam locomotive of tomorrow? And how will it differ from the one we have today? Materially higher pressures will be used without any sacrifice of safety, and with greater economy. Reciprocating engines will be used until turbines prove their superiority which, if they do, will take considerable time. Valves and valve gears may be changed in principle from what we are now using, and the steam produced more economically will have to be utilized more economically. Two and three cylinders will be used, both simple and compound, and the possibilities of limited cut-off will be further developed. Superheat will be increased. Back pressure will be reduced; better materials will be used; maintenance will be systematic, not spasmodic, and the locomotive designed so that running repairs can be quickly and easily made, and general repairs only after satisfactory mileage has been obtained. Better means of lubrication will be provided so that in all, greater economy and reliability will be produced and the records of today, good as they are, will be eclipsed by those of tomorrow.

The railroads will decide, after all, just what the locomotive of tomorrow will be. The builders are prepared to develop and build it for them. You men have a great influence in determining the answer to this problem. The successful utilization of the locomotive depends, in a large measure, on you. While the builders are striving for increased efficiency, it can only be realized by zealous effort on your part in perfecting the technique of operation. On you devolves the duty of instruction in approved methods, if maximum economy of operation and maintenance is to be attained. Without your co-operation, the most efficient product of the builders can make only an indifferent showing. Your assistance has been of great value to us in the past and we now ask that it continue so that we may build as the locomotive of the future only that which represents the ideal from the standpoints of safety, minimum stresses on track and bridges, maximum output per unit of time, low fuel cost, low maintenance cost, and convenience and comfort for the engine crew.

Improved operating methods

By A. R. Ayers

Assistant general manager, New York, Chicago & St. Louis, Cleveland, Ohio

Freight of all kind is moving today at higher speeds than ever before, and in order that operating costs may be cut down, this freight must be handled in large train units. These things require a steam locomotive that will develop a great amount of power at high speed.

How well the builders and designers are meeting these conditions is shown by a comparison of a recent Mikado with one built in 1913; the later engine has only 17 per cent more total weight, but is about 40 per cent stronger at the start, 40 per cent at 20 miles per hour, 60 per cent at 30 miles per hour and develops 60 per cent more maximum cylinder horsepower. It will do nearly 60 per cent more work per pound of coal than the early design.

The locomotive today will run about twice as far between general repairs as it would 20 years ago, and the liability of failure is very much less. Machinery parts, including cylinders, wheels, rods, frames, etc., have been lightened and strengthened by better design, and the use of high quality steels, and the weight saved in this way has been put into better boilers and fuel saving devices. New features are being developed constantly, and by continued attention to these things we can increase the capacity of the locomotive, increase the mileage between shoppings and cut down the amount of attention required in the meantime.

Correct use one of the greatest problems

Assuming that the engine is well designed and built and maintained, all of which is pretty well done today, there remains the great problem of using it to the best advantage. Traveling engineers and traveling firemen may play a most important part in developing the loading and operating of modern high-powered locomotives to take full advantage of their capacity and economy. In doing this they may, of course, receive much benefit from the locomotive and specialty service men who are experts in their particular lines.

We spend considerable money for devices that will save 10 to 25 per cent of the fuel, but it is a fact that can easily be demonstrated by actual test that poor firing or working the engine with wrong throttle and cutoff may easily waste from 10 to 15 per cent of the fuel. Light loading of trains is perhaps even more wasteful.

Four items that vitally affect the capacity and economy of the steam locomotive are cutoff, throttle opening, back pressure and draft.

If a steam locomotive is worked beyond 35 per cent to 40 per cent cutoff, the consumption of steam increases far beyond the proportionate increase in power; in other words, the engine becomes wasteful of steam.

Economies produced by two-cylinder limited cutoff engines and three-cylinder engines which are brought about partly, at least, by working steam at considerably shorter cutoff than ordinary practice, have caused us to run a number of tests to determine whether our locomotives are being operated at or beyond the point of economical cutoff. During these tests the engines were operated under full throttle practically all of the time.

On some of these runs, it was found that the cutoff was over 40 per cent about seven-eights of the time, and on one run, which was a fast heavy tonnage train, the engine was worked over 50 per cent cutoff 89 per cent of the time; these engines were U.S.R.A. Mikados equipped with feedwater heaters and boosters.

To carry the tests further, the cylinder diameter on one engine was increased from 26 in. to 27½ in., and the maximum cutoff with reverse lever in the corner reduced from 90 per cent to 75 per cent. Handling trains of practically the same weight and speed as another engine of the same class, the modified engine was over 40 per cent cutoff only 39 to 43 per cent of the time, compared with 86 to 88 per cent of the time for the standard engine, and the modified engine showed only 3 per cent to 9 per cent economy in fuel and about

the same in water; the saving was, of course, greater on heavier trains.

The need for improved drafting

Much remains to be accomplished in developing means for producing the necessary draft on a locomotive without so much sacrifice of power due to back pressure.

The importance of back pressure is, of course, recognized, but may be emphasized by the statement that one pound of back pressure on a locomotive with 26-in. by 30-in. cylinders and 63-in. drivers at 35 miles per hour is equivalent to about 30 hp.

Somtime ago two Mikados were equipped with a device for automatically controlling cutoff according to back pressure, and these engines demonstrated that where maximum power is required there is considerable gain in power as well as economy by working with full throttle and with cutoff adjusted to keep the back pressure within reasonable limits. These limits will, of course, vary according to the type of engine, kind of fuel, etc.

Since that time, a number of locomotives have been equipped with back pressure gages, and the enginemen seem to be glad to have such gages on their engines, because the modern locomotive is so large that it is difficult for the engineer to operate it to the best advantage when relying only on his judgment assisted by the sound of the engine.

Feedwater heating devices in operation will reduce back pressure from 2 lb. to 4 lb. and on engines with large grates, automatic stokers, by carrying a thin, even fire, make it possible to get the maximum boiler capacity with less draft and consequently less back pressure than would be needed with heavy fires.

On large engines, the plain round exhaust nozzle does not appear to give as much draft per pound of back pressure as some form of nozzle which breaks up the exhaust jet and in this way provides more entraining surface for the front and gases.

Results of improvements in the locomotive and in operating methods

This is a subject of first importance in connection with locomotive operation today, and to show how far it can be carried it may be stated that engines which were formerly operated with 5¾ in. plain round nozzles are now in successful operation with specially designed nozzles having an area equivalent to a 6½ in. plain round, resulting in considerable increase in power, without any sacrifice of steaming qualities.

On one division where the size and type of freight power has been unchanged for four years, except that some of the later engines are equipped with boosters and feedwater heaters, the average tonnage per freight train in the direction of heavy traffic has been increased 360 tons with an increase in speed of about ¾ miles per hour. This figure is quoted to show what can be done partly by application of betterments and partly by attention to train loading and best methods of operating the locomotives.

Many notable examples of long engine runs on freight trains, as well as passenger trains, have been published in recent months. The modern locomotive is entirely capable of running several hundred miles on either passenger or freight trains without repairs, and the advantages of this practice are so many that there seems to be no doubt that it has come to stay, not only for oil-burners but also for coal-burners.

Among the advantages are the saving of fuel, otherwise wasted at terminals; saving in cost of terminal handling; better maintenance; more serviceable engine hours, and last but by no means least, the general speeding up of freight train operation through the elimination of most of the delays waiting for power, and the consequent incentive to the transportation department to make up its trains and handle its terminal yard work so as to take full advantage of the through runs.

As far as maintenance is concerned, the long runs force good maintenance, and at the same time make it easier, because long runs generally carry with them longer lay-over periods which afford plenty of time to do the necessary work on the engine, and this time is not always available on short runs with quick turns.

Some progress has been made with locomotives of this type in Europe, but not much in this country on account of cost and the large size of locomotive involved.

The use of much higher boiler pressures with some form of water tube boiler construction appears to offer one of the most attractive fields for radical changes in steam locomotive design in the near future.

Discussion of the locomotive today would be incomplete without reference to electric and internal combustion locomotives. Both of these systems have the advantage of very high starting power and more serviceable hours per locomotive per day. In addition, the internal combustion engine has a lower fuel cost than the steam locomotive, and the electric locomotive is apparently somewhat cheaper to maintain, although somewhat restricted in its field of operation, on account of requiring trolley wires or third rail. The steam locomotive, however, still holds the great advantage of much lower first cost, and is making great strides in fuel economy and starting power.

No doubt all three of these systems will continue to develop rapidly according to the demands of the service in which they operate.

Provide modern power and use it intensively

By O. S. Jackson

Superintendent of motive power and machinery, Union Pacific

In the year 1903, on a representative division of the road with which I am connected, the heaviest freight locomotive of that period had a ton-mile-hour capacity of 13,500. Today the 4-12-2 three-cylinder locomotive, termed the Union Pacific type, develops on that division a ton-mile-hour capacity of 80,000. Thus, in a period of 23 years, the locomotive unit in that territory has increased its earning capacity in a six to one ratio.

The physical characteristics and limitations of most American railroads are today rather definitely fixed, because further property extensions in extra main line track, grade revisions or extensive terminal enlargements are usually financially prohibitive.

Facilities for increase in traffic capacity when the necessity arises, must therefore follow the line of least economic resistence, which requires that a given mileage of rail shall be made to carry its maximum number of gross tons each hour of the day, before additional rail mileage is permissible.

If we review the past 20 years of rail transportation with this thought in mind, we are forcefully impressed with the very large increase in traffic volume that has taken place, compared with the relatively small increase in railroad mileage in the same period of time. The principal elements involved in this intense development are larger cars, faster movement and more powerful locomotives. Relatively speaking, locomotive unit power which embraces the element of faster movement, has grown much the more rapidly during this period. The steam locomotive has therefore contributed as a large

factor in the growth of modern rail transportation.

Recent design development

Realizing that the conventional two-cylinder locomotive has about reached its practical limit of size, weight and hauling capacity under present road limitations, locomotive designers have recently brought into the field at least two outstanding proposals for increasing hauling capacity without increasing axle loads, total weight or clearances.

I refer to the restricted cutoff locomotive, and to the three-cylinder locomotive—both of which types have made gratifying progress, and in a sense are based upon the same fundamental idea that the adhesive ratio may be reduced and more piston thrust employed, if a more uniform torque is introduced. And as both types also employ higher average rates of steam expansion than previous simple engine types, there is an attendant economy in fuel and water at the cylinders in addition to the extra power output.

These two locomotive types appear to offer at the present time the broadest and surest field for immediate progress in improving the steam locomotive, although I should not forget to mention a recent trend in locomotive boiler development that appears to carry fine possibilities for improvement in capacity, weight, higher pressure, maintenance and safety—namely, the water tube locomotive boiler in its several recent designs. I predict, however, that the water tube boiler will have to fight hard for recognition and approval, owing to our fixed conception and prejudice in regard to what really constitutes a locomotive boiler.

To my knowledge, with the exception of one isolated attempt many years ago, no one has, until quite recently, attempted to couple more than five pairs of driving wheels into one system. It seems obvious that to do so in combination with two outside cylinders would be to invite serious mechanical troubles, if not entire failure because outside cylinders of such large diameter would be required that their piston thrust could not be successfully transmitted through one main rod and one main pin and axle to six or more connected driving wheels.

The successful introduction of the three-cylinder locomotive in three, four and five coupled types has brought about, quite conveniently, a new possibility which did not exist before, and I refer to the conception of one of our mechanical officers resulting in the 4-12-2 or Union Pacific type three-cylinder locomotive with six coupled driving axles. As the middle cylinder drives the No. 2 or crank axle, while the two outside cylinders drive the No. 3 axle, a design is obtained where the driving stresses are divided up in a manner permitting better distribution of the load through frames, sides rods and crank pins, than can be obtained in the usual 2-10-2 type with outside cylinders. The sixth or additional axle permits a 20 per cent increase in traction; the third cylinder permits the use of a lower adhesion factor resulting in a 20 per cent increase in traction per axle. Thus, compared with a 2-10-2 two-cylinder type locomotive, 44 per cent increased tractive force is secured without increasing the unit axle load a single pound.

In May of this year, a locomotive of this type was delivered by the American Locomotive Company, and subjected to a rigorous practical operating test to determine its capacity, mechanical performance, and approximate fuel performance, looking toward establishing the type for additional heavy freight power in the mountain territory, if successful.

A carefully conducted fuel, water and indicator test of a month's duration has since been made and the report of this latter test is now being prepared, and will be available shortly for those who may be interested in the performance of this new type locomotive. Fourteen additional locomotives of this type have recently been delivered to our lines.

Results obtained with three-cylinder locomotives

It is the largest and most powerful non-articulated locomotive and when it was being tested it pulled the same tonnage as our Mallet locomotives on the 1.55 per cent grade between Cheyenne and Laramie at increased speed and reduced fuel consumption. On the 0.8 per cent grades between Laramie and Evanston, this locomotive, in comparison with the Mallet type demonstrated its ability to produce 80 per cent more ton miles per hour than the Mallet, both engines having equal starting tractive force. It has demonstrated its ability to produce these results on slightly less than half the Mallet fuel per thousand gross ton miles. A 48 per cent cutoff has been maintained at 42 miles per hour, developing 4,750 hp. at that speed.

This engine has successfully hauled 3,500-ton fast fruit trains between Wahsatch and Laramie, over four Districts (a distance of 361 miles) at an average running speed of 27.4 m.p.h., thereby earning one and one-third million gross ton miles per continuous trip in 18 hrs., 48 min. total time, or 13 hrs. and 15 min. running time, and while this performance was over a territory having many grades of 43 ft. per mile, the average coal consumption was 62 lb. of dry coal per thousand gross ton miles.

The question of obsolete locomotive

If we are to judge the future development of the steam locomotive by past experience and knowledge, we must admit that the possibilities for improvement in design, capacity and performance in the future are equally as good as they have been in the past. All classes of men today, dealing with the locomotive, are more highly educated and more highly trained than in the past. We have the knowledge of the past as a ground work for the future. The old cut-and-try methods of the early days have given place to scientific analysis and test work, thus avoiding a great deal of useless effort and expense.

The future appears to offer at least two very prolific lines of economic advancement in locomotive development and operation, either of which, or combined, will, if adopted, bring about remarkable economies. I refer, first, to the obsolescence of old light and uneconomical locomotives; and second, to the intelligent and maximum utilization of legitimate locomotive power. It is understood that I am speaking in general or average terms, realizing the exceptions that must be made to cover certain operating conditions; however, wearing out antique power is an expensive luxury on any railroad.

In general, there are on American railroads today, many small old locomotives, with low boiler pressure, saturated steam, low hauling capacity and high unit maintenance, that should either be equipped with modern economic devices and confined to service where they will meet the traffic conditions, or, if this is not done, should be relegated to the scrap heap.

The last several years have seen a very remarkable development in the steam locomotive as a thermal machine, not to mention the increase in unit capacity. These new types can be conservatively rated to develop each horse power on one-half the fuel and water used by old saturated power. Can the railroads afford to keep

obsolete power in service? Surveys of this light power should be made to determine upon which side of the ledger such locomotive power finally falls. With the substantial economies of lately developed types of super-locomotives well established and before us, we are in possession of the necessary elements to estimate the balancing point of obsolescence of old power, and no fear, sentiment or favor should prevent obsolescence where the answer is obvious. We can no more afford to perpetuate this obsolete power on the railroads than to perpetuate obsolete machine tools in the shops.

Long locomotive runs

The second development to which I have referred, namely, the best utilization of locomotive power, becomes a separate and different problem for each railroad property. It goes without saying that any increase in service hours of a locomotive is a direct financial gain. Undoubtedly one of the foremost factors in gaining service hours is the increase of mileage per month per locomotive through means of long locomotive runs. For example, on the road I am connected with we are today, during our peak business, getting from 35 to 40 per cent greater mileage out of our heavy freight power than was possible when locomotives were assigned to engine crew districts.

In March, 1921, we started operating passenger locomotives 225 miles over two districts, between North Platte and Cheyenne. A year later passenger locomotives were operated 284 miles, over two districts, from Council Bluffs to North Platte. Later North Platte was cut out resulting in a 509 mile run from Council Bluffs to Cheyenne.

Long locomotive passenger runs are established as follows:

Council Bluffs, Iowa	to Cheyenne, Wyoming	509 miles
Council Bluffs, Iowa	to Denver, Colorado	562 miles
Cheyenne, Wyoming	to Ogden, Utah	483 miles
Denver, Colorado	to Ogden, Utah	577 miles
Denver, Colorado	to Kansas City, Missouri	642 miles
Cheyenne, Wyoming	to Salt Lake City, Utah	519 miles
Cheyenne, Wyoming	to Pocatello, Idaho	552 miles

These runs are operated with Pacific type or Mountain type locomotives depending on the grade conditions to be overcome.

In freight service are the following established long runs:

Omaha, Nebraska	to North Platte, Nebr.	284 miles
North Platte, Nebr.	to Cheyenne, Wyoming	225 miles
North Platte, Nebr.	to Denver, Colorado	278 miles
Kansas City, Kansas	to Ellis, Kansas	303 miles
Ellis, Kansas	to Denver, Colorado	337 miles
Laramie, Wyoming	to Green River, Wyoming	251 miles
Green River, Wyoming	to Ogden, Utah	176 miles

These long locomotive runs have all been successful from every standpoint, and the following benefits have been obtained:

Twenty-five percent less locomotives required to handle an equal amount of traffic.

Reduction in enginehouse expenses per locomotive mile.

Reduction in consumption of fuel and supplies by eliminating layover at intermediate terminals.

Reduction in running repair charges per locomotive mile.

Maintenance costs for repairs of facilities at intermediate points greatly reduced, if not eliminated entirely.

Expenditures for additions and betterments at intermediate terminals to meet expansion of business avoided.

Reduction in mileage of engine crews taking locomotives to and from the enginehouse.

Engine failures materially reduced as a result of more thorough inspection and repair facilities at main terminals where a more systematic and uniform plan of maintenance can be executed.

Length of time to get trains through intermediate terminals greatly reduced.

To successfully operate these long runs, the engines must be kept in first class serviceable condition, and in our experience we have found the periodical locomotive repairs at terminals, as outlined some time ago in the railroad journals, has been an important factor in making this a success.

A very striking example of locomotive utilization has recently come under my observation in the standardization of locomotive running by means of the Duplex back pressure and initial pressure gage. The subject has been covered in a recent article in the railroad press, but it is pertinent to direct your attention to our experience, where a careful survey disclosed a startling variation in the individual habits employed by different enginemen, resulting in wide variation in fuel and water economy and time over the road. The operating gage is now standard on all our road engines, and I can recall no single instance in my railroad experience where such substantial economy has been obtained with so small an expenditure.

Fuel organization separate unit

Essentially in the operation of the modern locomotive cost of operation is an important factor. Nowhere is greater opportunity offered to economize than in the consumption of fuel. "Save a shovelful of coal" is a slogan that most of the larger and more progressive railroads have adopted.

On our line we have an aggressive fuel organization reporting direct to the general manager, working hand in hand with the mechanical and other departments to accomplish the greatest good. While I appreciate that most operating and mechanical men are of the opinion that fuel men should report directly to the mechanical organization, I think our results have demonstrated two things. First, that we have entirely eliminated the possibility of fuel men not getting results through their being dominated by master mechanics or other mechanical officers, to the extent that engines are permitted to go into service that are not in condition to handle maximum tonnage economically. Second, that a fuel organization composed of practical men is available to the operating department to check operating problems that are not directly connected with the mechanical organization.

Another feature is that where enginehouse foremen, district foremen and others understand that these fuel men are sending engines back to the house that are not in condition, there is less of a disposition on their part to take chances.

Our fuel organization has not only interested itself in the matter of saving fuel but we have practically eliminated fires due to defective front ends and defective ashpans through the activity of the fuel organization working with the mechanical department along these lines.

While the foregoing is perhaps a radical departure from the views of most mechanical men, we are strongly of the opinion that this is the proper organization and that we have made a practical demonstration of the comparative efficiency of the two methods that have just been briefly described.

The best utilization of locomotives also requires a systematic maintenance of the power, as the locomotive of today cannot be expected to produce maximum economy and performance unless maintained in the best of condition. It would seem to be the imperative duty of the men in your organization to not only see that enginemen are properly and thoroughly trained in their present day duties, but they should check and know the power and when not found in good condition, locomotives should be returned to the mechanical forces and not be permitted to run with resultant waste of fuel, loss of time and engine failures.

Traveling engineers' program has broad appeal

Big improvements shown in the motive power unit and in utilization of its potential capacity

THE inclusion in the program of the thirty-fourth annual meeting of the Traveling Engineers' Association of a symposium on The Locomotive of Today, participated in by railway operating and mechanical officers as well as by officers of the builders, makes the proceedings of this convention of interest not only to the traveling engineers themselves, but to all operating and mechanical department officers having to do in any capacity with the design, maintenance, operation or utilization of railway motive power. Extended abstracts of the papers presented in this symposium, which occupied the sessions of one entire day, will be found on another page of this issue.

Reports and papers which were presented and discussed during the other three days of the convention dealt with smooth train handling; locomotive availability; the growing job of the traveling engineer; the booster; automatic train control, and instructions for new firemen. The convention was also addressed by Interstate Commerce Commissioner Frank McManamy and by A. G. Pack, chief of the Bureau of Locomotive Inspection of the Interstate Commerce Commission, the address of the latter dealing extensively with the problems of utilizing autogenous welding in locomotive maintenance. In a brief address, Thomas H. Carow, chairman of the Safety Section, American Railway Association, commented briefly on the program of that section for a 35 per cent reduction in accidents by 1930 and appealed to the traveling engineers to co-operate with the Safety Section in making this goal. Mr. Carrow's address was preparatory to a definite program whereby road foremen of engines, trainmasters and master mechanics are to assist in the development of the Safety Section program for accomplishing this result.

The convention was held at the Hotel Sherman, Chicago, September 14, 15, 16 and 17, with J. N. Clark (Southern Pacific), the president, in the chair. Following the customary opening exercises, President Clark addressed the convention. His remarks are given in abstract below.

President Clark's address

During the past year it became my pleasant duty to select two committees from our membership to co-operate with the American Railway Association's committees on Locomotive Utilization, and Locomotive Construction and Design. Invitations have been extended to the chairman and members of those committees to attend our convention. The very friendly attitude of Mr. Aishton and other officers of the American Railway Association is, I am sure, very much appreciated by this association.

The responsibility of the traveling engineer increases with the ever increasing demand for better transportation. Coming within our immediate supervision is a vast army of 133,000 locomotive enginemen and firemen who look to us for education, guidance and inspiration. Our managements look to us for expert advice on everything that pertains to the modern locomotive, proper distribution of power to serve the industry best, advice upon all new locomotive appliances, fuel economy and smooth train handling to insure a safe and on-time performance.

There is only one way through which we can render satisfactory service, and that is through education, and what a wonderful medium we have, to acquire education through our association. There is not a member who has not had many of his most troublesome problems solved by having them discussed at our annual gatherings. Grouped in the next room is the finest and most complete collection of modern locomotive appliances ever assembled, and each device is presided over by an authority who is not only willing but anxious to impart to you the knowledge he has gained through intensive study.

Seven new records were established by the railroads of the United States in 1925. Included in this remarkable performance are several records over which the traveling engineer has direct supervision. Are we not, therefore, justified in feeling proud of these accomplishments? Our records mean nothing to Mr. Aishton; he makes them today, only to break them tomorrow.

But don't you get a "kick" out of breaking records? Let us pick up enough new ideas during the next four days to go home and smash all the records he can put up for us to shoot at during the next 365 days.

Progress means going forward and civilization has shown the greatest progress where transportation has been developed to its highest efficiency. China, with a population of 400 million, has less than 7,000 miles of railroads to serve its four and a half million square miles of territory, while the United States, with a population of 116 millions, has over 250 thousand miles of railroads to serve its three million square miles of territory. Transportation has been the big civilizing influenc in ours, and every other country, and we should feel a just pride in our contribution to such an industry.

Election of officers

In addition to the addresses and technical numbers on the program, abstracts or summaries of some of which appear below, the association elected the following officers to serve for the year 1926-27: President, J. B. Hurley, general road foreman of engines and fuel supervisor, Wabash, Decatur, Ill; first vice-president, J. D. Heyburn, master mechanic, St. Louis-San Francisco, Ft. Smith, Ark.; second vice-president, James Fahey, traveling engineer, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; third vice-president, Ralph Hammond, traveling engineer, New York, New Haven & Hartford, Providence, R. I.; fourth vice-president, A. N. Boyd, road foreman of engines, Canadian National, Turcot, Que.; and fifth vice-president, H. B. Kelly, general road foreman of engines, Pittsburgh & Lake Erie, McKees Rocks, Pa. Davis Meadows, assistant division master mechanic, Michigan Central, St. Thomas, Ont., remains as treasurer, and W. O. Thompson, general superintendent rolling stock, New York Central, Buffalo, N. Y., secretary. Two new members were elected to the executive committee as follows: D. L. Forsythe, general road

foreman of equipment, St. Louis-San Francisco, Springfield, Mo., and J. Keller, superintendent fuel department, Lehigh Valley, Bethlehem, Pa.

Address of Commissioner McManamy

In addressing the association, Commissioner Frank McManamy said that the Interstate Commerce Commission is interested in results for which the traveling engineer probably to as great an extent as any other single class of railroad employees is responsible. He referred to the previous mention of the expensive operation of the New York barge canal, stating that erroneous conclusions are almost sure to be drawn from statistics unless all conditions are known and taken into consideration in interpreting them. The canal for example has been trying to get railroads to interchange freight with it unsuccessfully and, Mr. McManamy said that the case would probably eventually go to the United States Supreme Court for final decision. He asked what railroad could be operated successfully if the roads at its most important terminals refuse to interchange freight with it.

All railroads furnish statistics to the Interstate Commerce Commission and the figures indicate remarkable results in improved operation during the past few years. Mr. McManamy quoted figures to show the improvements made, some of which are as follows: since 1916 the number of locomotives has increased 4.3 per cent, the total tractive force 27.8 per cent, the average tractive power per locomotive 22.5 per cent, the total ton miles 15.1 per cent, ton miles per mile of road 11.5 per cent, passenger miles per mile of road 1.3 per cent, revenue tons per train 23.5 per cent and revenue tons per loaded car 15.3 per cent. The traveling engineers who play an important part in securing this improved railroad operation should continue their efforts.

Mr. McManamy explained that there are twenty-eight separate acts of Congress to be enforced by the Interstate Commerce Commision, nine of which relate directly to safety. With the small force which the law provides it would be impossible to secure anything approaching enforcement of these laws without the co-operation of railroad officers. Experience over the past nineteen years indicates that at no time has the commission secured the co-operation of railroad men more fully than at present and consequently at no previous time has railroad equipment been so well maintained. McManamy then quoted statistics showing the improvements in railroad operation as regards safety, but said that further improvement can be made with the Interstate Commerce Commission working with the railroads one hundred per cent.

This does not mean the shutting of inspectors' eyes to defects, which is not co-operation in the real sense of the word.

Abstracts from Mr. Pack's address on fusion welding

The program which you have outlined has been admirably chosen to cover railroad operation, locomotive design, construction, operation, inspection and maintenance, together with needed shop facilities, all of which I am deeply interested in. I hope that what I have to say will be accepted in the same broad spirit in which it is given and as being in the interest of the designers, builders, operators and maintainers, as well as the patrons of the railroads whom we are all trying to serve in the most intelligent, satisfactory and economical manner.

I have read with deep interest your committee reports and subjects for discussion at this meeting. Especially do I want to congratulate you on the paper prepared by your committee on the subject "Locomotive availability in 100 per cent condition, up-to-date roundhouse and terminal facilities, and up-to-date methods." I am very thoroughly in sympathy with the manner in which this subject has been handled by this committee. It contains much information which, if taken advantage of, will prove of great value to all who may be interested in the safe and economical operation of the railroads.

I have had a great deal of experience with the use of autogenous or what is now more commonly termed fusion welding and the effect upon safety of its indiscriminate use in the construction and repair of locomotives and tenders. Therefore, I desire to give you the benefit of some of my knowledge of the subject based on experience and study since the inception of its general use by the railroads.

Consideration of what actually occurs during fusion welding and the results obtained therefrom, may be of assistance in enabling us to determine how far we should go in using this process. In the first place, fusion welding is simply the making of a casting between the metals being joined. The melted metal is deposited in small globules and is exposed to the air with chances of becoming oxidized or absorbing gases. It is difficult to avoid overheating or burning of the metal, and too often the weld is porous and contains slag and oxides. In the final analysis the weld is a casting, it may have all the defects of an inferior foundry casting, even when the weld appears to be of the best quality. It is coarse grained, is lacking in the desirable quality of ductility, and has comparatively little resistance to alternating stress and shock. Furthermore, no known method of inspection, other than a test to destruction, will reveal the strength or other properties of the weld.

Another feature of great importance is that internal stresses are produced in welded structures by the heat of the welding process; these stresses are largely concentrated in or near the weld but may extend for considerable distance into the parent metal.

With steel of a higher carbon content than 0.25 per cent, alloy steels and heat treated steels, such as are often used in locomotive rods and motion work, the intense heat of welding starts minute cracks which eventually result in failure. The time that elapses before failure occurs depends to a great extent upon the service stresses to which the part is subjected.

Torch cutting has an effect on the material similar to that of fusion welding. On low carbon steel the internal stresses and the transformation of the metal at the cut surface are relatively small and can be disregarded for many uses. With steels above 0.25 per cent carbon content this method of cutting should not be used unless the transformed zone which contains innumerable minute heat cracks, is removed by machining.

Much has been said and written on this subject of making good fusion welds and particular stress is usually laid on the quality of parent metal and welding wire, preparation of the material to be welded, proper welding welding equipment, and the ability, skill and integrity of the operator. However, it is my opinion that success with fusion welding consists more largely in restricting its application so that doubtful or dangerous jobs will not be attempted, rather than on the technique of the operation, though the latter is by no means of minor importance.

The question is frequently asked, "Is fusion welding permissible in locomotive firebox and boiler construction and repairs?" I am of the opinion that fusion welding, in the present state of the art, should not be used on

parts of the locomotive, boiler, or tender where through failure of such parts there is a probability of accident and injury to persons. Its use in stayed surfaces where failure would not result in personal injury and where the magnitude of the working stresses is small, and in locations where the welding is not subjected to overheating, seems to be relatively safe.

(Mr. Pack here listed a few typical failures indicating locations where fusion welding should not be used, such as boiler barrel, auxiliary steam dome, wrapper sheet seam in cab, driving wheel tires, engine truck wheels, main rods, etc.—Editor.)

Another use of fusion welding with which I am very much concerned is its application to locomotive fireboxes in the areas which may be subjected to overheating.

During the period July 1, 1915, to June 30, 1926, fusion welded seams were involved in 28 per cent of the total crown sheet failures, while 51 per cent of the total persons killed in crown sheet accidents were killed where fusion welded seams were involved. Of the riveted seams involved, 16.3 per cent failed, while 77.2 per cent of the fusion welded seams failed under exactly the same conditions. The average number of persons killed per accident in which the riveted seams were involved was .77 as compared with an average of 1.16 killed per accident where the fusion welded seams were involved.

It is a well recognized fact that serious explosions cannot occur if the rupture in the boiler is not of sufficient size to reduce suddenly the pressure. Explosions never occur with sufficient severity to throw the boiler from the frame unless the sheets tear and release the pressure suddenly. Strong firebox seams not only lessen the number of persons killed and injured per accident but effect a material saving in the destruction of property.

It may be said that a large percentage of the crown sheet failures involved in this discussion were caused by overheating due to low water, therefore, the primary causes of such failures were overheated crown sheets, and that nothing can prevent a crown sheet from coming down when allowed to become extremely overheated. I agree with this. But when a stronger construction of the firebox seams will reduce the number of fatalities and the damage to property, I feel that there can be no excuse to offer for not employing the strongest and best practical methods.

Crown sheet failures caused by low water may be likened to railroad accidents such as collisions and derailments, in which steel and wooden coaches are involved. Wooden coaches never cause fatalities unless involved in serious accidents, such as derailments and collisions. There is almost a universal demand for the substitution of wooden coaches by steel coaches because of the greater protection to the life and limb of the traveling public when serious wrecks occur. The best and safest methods should always be employed.

I do not desire to be understood as opposing fusion welding when properly and discreetly used, and believe that it has a very wide and useful field. If we are to profit by the experiences of others, we must give careful consideration to the result of all practices and methods. The extreme to which fusion welding has been carried is what I have taken exception to. It is not "a cure-all," nor can it be used indiscriminately with safety, nor even economy.

Smooth train handling

The committee on "smooth train handling" divided its subject into two parts and submitted a questionnaire to each member of the association consisting of 13 questions designed to bring out the general practice in starting and stopping passenger trains and a similar questionnaire for freight service. Answers to the questionnaires did not come from anywhere near the entire membership of the organization nor all of the Class I roads and are rather indefinite. It was brought out that the railroads are not operating their trains as nearly alike as possible or in such a way as to obtain the best results both from the standpoint of operation and maintenance. To quote from the committee report:

"While it is a conceded fact that the characteristics of roads differ considerably and that it would appear almost impossible to have more uniformity by all of the railroads, yet your committee feels that a set of rules could be worked out that could be used by all of the railroads as far as smooth train handling is concerned.

"In preparing this paper your committee has found that the subject requires a very thorough consideration of more important points as follows: maintenance, starting, speed and stopping under all conditions."

The committee then gave consideration in its report to passenger service, calling attention to the importance of maintenance, not only of the air brake equipment but of various parts of cars, particularly drawheads and couplers so that an entire train can be handled as a unit. Detailed instructions for handling trains are given in the report with due attention to double-heading, graduated release stops, two application stops, the use of retaining valves, stops for coal and water and emergency stops.

In discussing freight train handling considerable attention was given to methods of making slow-downs and stops, also brake applications on mountain grades. Regarding heavy grade braking the committee said:

"For this work the cars in the train should be specially prepared in the way of taking care of the piston travel; this should be made as uniform as possible—between 5 and 8 in. standing travel. Brake pipe leakage should not exceed 6 lb. per min. from 55 lb. or with a 15-lb. reduction from 70 lb. brake pipe pressure, and 100 lb. main reservoir pressure. On heavy grades of 1½ per cent or above the brake pipe pressure should be raised to at least 90 lb. and main reservoir pressure to 130 or 140 lb. Retaining valves should be specially prepared so that when placed in holding position and a 25-lb. brake pipe reduction is made and the brakes released with retaining valves set for holding position, at the expiration of 2½ min., the retaining valves will be turned to release position. Any retaining valves that fail to hold air and blow at the release port after the required 2½ min. should be replaced or repaired so that they will hold the required time. This is very important for grade work to prevent the overheating of wheels on some cars due to others not holding properly."

The committees also gave special consideration to the handling of long freight trains, the prevention of slid flat wheels and air brake test rack manipulation.

The report was signed by Frederick Kerby, Baltimore & Ohio, Cumberland, Md., chairman; R. I. Cunningham, Westinghouse Air Brake Company, Pittsburgh, Pa.; B. J. Feeny, Illinois Central, Chicago; James Fahey, New York, Chicago & St. Louis, Nashville, Tenn.; and A. H. Hoffman, Southern Pacific, Los Angeles, Cal.

Discussion

The discussion of this report dealt almost entirely with the use of the brakes to avoid rough handling. There was some disagreement as to whether the best method of stopping is to keep the slack stretched at all times, but as far as it could be determined from the discussion, the consensus of opinion is in favor of this practice in freight trains, keeping the throttle partially open and the driver

brakes off. Several variations of this method were described, particularly in slowing down where stops are not required except to avoid excessive rough handling of the train. The use of the open throttle was questioned by one member because of the apparent waste of fuel this practice implies. The opinion was expressed by others, however, that the saving of time resulting from the more rapid application of the brakes possible when the slack is kept stretched by the open throttle and release driver brake method, as compared with the practice of closing the throttle, allowing a gradual run-in of the slack and then applying the brakes, more than offset any loss of fuel caused by the partially opened throttle during the period required by the stop.

Most of the members who discussed the report stated that their railroads were using the graduated release feature of LN and UC equipments where passenger trains are equipped with these brakes and the value of graduated release as a means of preventing rough handling was strongly endorsed. One case was cited where, on a three per cent grade, the brakes were applied continuously for 29½ min., with a 90-lb. brake pipe pressure, and at the bottom of the grade the brake pipe pressure was still 70 lb. The practice in this case, after starting on the down grade, is gradually to bring the brake pipe pressure down as the speed increases until a balance is established as the desired maximum speed is reached.

The importance of keeping down brake pipe leakage was emphasized by several of the members speaking, one member suggesting that a big improvement could be made by car inspectors if they would carry wrenches and tighten the unions in the brake pipe and crossover pipe. These unions, he said, would frequently be found loose enough to permit from ¼ to ½ turn, a condition which otherwise would not be discovered without the soapsuds test which it is impracticable to use except at regular repair periods. The use of a one-car test device on every car passing over the repair tracks was also advocated as a fundamental step necessary in making each car as nearly free from leakage as possible. The necessity of tight clamps to maintain good conditions when once established was also emphasized and another step toward maintaining the satisfactory freedom from leakage was also mentioned in this connection—the equipment of transportation yards with air lines.

Locomotive availability — Up-to-date terminals

In approaching the question of locomotive availability through a greater utilization of the power and considering the human element which if not given serious thought is sure to result in failure, there are several factors to consider. Among the first are custom or past practices, long established; failure of the management to educate the employees to the extent that they will heartily co-operate, and if not oppose at least be lukewarm; failure of the subordinate officers to realize the magnitude of the capital expenditure involved and the resultant interest and depreciation charges, and the savings that will accrue through greater power utilization, and resultant increased mileage and tonnage handled per locomotive per year.

Up-to-date terminal facilities needed

Now that we have an improved stoker-fired steam locomotive which compares much more favorably than formerly with the best stationary steam practice in efficiency, more thought must be given to improved terminal facilities. The efficiency of a modern steam locomotive under favorable operating conditions is already so high that we cannot anticipate any radical improvement in this direction. Does this mean that if motive power efficiency is to be further improved it must be in the direction of the Diesel engine or electric traction? Further economies of the modern steam locomotive will depend largely upon our ability to eliminate stand-by and terminal losses to which this type of power is now subjected, and reduce its non-revenue hour ratio.

Two of the strongest economic arguments in favor of electrification or the Diesel locomotive are the elimination of terminal losses; not only the loss of fuel consumed by steam locomotives during their lay-over periods, but loss on the investment incurred by locomotives standing idle at terminals. Statistics show that steam locomotives on all Class I railroads average only about one-third of the time in revenue service and that at least 20 per cent of all locomotive fuel is consumed at terminals. These investment and fuel losses can be largely eliminated by electrification or practical development of the Diesel locomotive and by improved terminal facilities.

Had the efficiency with which locomotives are handled at the terminal been improved in proportion to locomotive operating efficiency, the situation would be different, but the facts are that at a majority of terminals there has been no fundamental improvement in type of facilities or method of operation. Where enginehouses have been enlarged and are better built, turntables have been lengthened and designed to operate more rapidly, coaling stations and fire-cleaning facilities have been perfected, as well as sufficient drop pits for handling of driving wheels, engine truck and trailers. With the advent of solid cast steel frames and six-wheel tank trucks, drop pit facilities should be provided for handling them quickly. Light electric traveling cranes operating on a monorail the full length of the roundhouse circle and between all drop pits speed up the work and make available for dropping of wheels the entire group of drop pits, so it is not necessary to keep one pit clear for wheel handling. Depressed spring tracks for handling spring work not only speed up several times the application of springs and spring hangers, but greatly reduce the hazard where engines are jacked to relieve weights and where spring pullers are used. A suitable hot water wash-out plant is a necessity, as also are blower lines of ample capacity.

Direct steaming offers possibilities of saving

A new departure from the old established routine handling of locomotives at terminals and with possibilities next to advantages derived from hot water wash-out plants, is the installation of direct steam for making ready engines at terminals. Proof of the practicability of this plan of speeding up the turning of power at terminals is the recent installation of direct steaming plants at the new Grand Trunk Western locomotive terminals at Battle Creek and new Chesapeake & Ohio terminals at Russell, Ky., and installations contemplated at Chicago and other locations. Absence of smoke and gases in the roundhouse, availability of the engine for quick call, ability to take the engine on quick call and immediately move out of the house to outbound ready tracks under its own pressure, making house room available, and automatically enlarging the capacity of the roundhouse, pressure of steam on the boiler to expedite spotting for work, and use of steam from an efficiently operated stoker-fired, forced draft, slack-burning power plants as against expensive steam consumption from the house blower and new inefficient green fire just started

in the locomotive, are some of the advantages claimed during the time the engine is having steam raised to working pressure.

Engines filled with water to the gauge and brought to working pressure in one hour, including filling can, if bedded previously but not lighted, be dispatched on fifteen-minute order for the engine.

This method seems to be both a radical departure and at the same time present installations indicate a practical and economical advancement in locomotive terminal facilities.

Up-to-date methods

The third part of the subject, "Up-to-Date Methods," naturally will bring us to the shops, roundhouses and mechanical organization.

The foundation of good locomotive maintenance is correct design first, then the use of proper materials and first-class and thorough general shop repairs at intervals based on a predetermined mileage governed by the type of power and local conditions.

The ability of machine tool manufacturers to produce modern tools that speed up the heavier operations is outstanding. The use of modern millers and grinders, rod machinery, annealing furnaces for frames, rods, etc., and carbonizing furnaces, normalizing processes, gas cutting and welding torches and many other improved methods are the medium of putting into service our modern locomotives so they can economically and safely negotiate runs of 500, 1,000 and more miles now and in the future with dependability.

The requirements of the Interstate Commerce Commission Bureau of Locomotive Inspection and the Locomotive Boiler Inspection Law have proved to be a blessing to the railroads of this country. Not only do they standardize locomotive conditions, but the mechanical department officers take advantage of the monthly, quarterly and many other stated inspection periods to add to the federal requirements many additional inspections of a precautionary character of their own that tend to maintain the locomotive in a much higher state of efficiency.

Give traveling company inspectors ample authority

Traveling company inspectors with authority to tie up power for defects are a great help in maintaining power at a high standard. These men examine all foremen and company inspectors on federal rules and grade them, and soon train a very efficient force of inspectors and qualify all foremen on the requirements of the federal rules. A traveling valve expert soon trains the mechanics selected at division points to look after valve gear and valve setting on the most acceptable methods of handling this class of work and maintaining valve parts to standard. This cost is repaid many times in fuel saved and uniformity of methods.

One of the greatest aids to maintain a high degree of efficiency is for the operating officer to set his mark so high and the service so exacting, and follow up any failure to attain the standards set, that all concerned will be compelled to keep in good condition the locomotives and the various devices on them which are intended to increase their capacity and to save fuel.

The report was signed by P. O. Wood, assistant superintendent of motive power, St. Louis-San Francisco, Springfield, Mo., chairman; Robert Collett, fuel agent, St. Louis-San Francisco, St. Louis, Mo.; F. P. Roesch, Standard Stoker Company, Chicago; R. McDonald, road foreman of engines, Michigan Central, St. Thomas, Ont., and J. E. Bjorkholm, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

Discussion

In the discussion of the report on locomotive availability reference was made to the importance of automatic flue blowers as an aid to efficient steam generation, and the necessity of special attention to the front end both as regards air and steam leaks. One member pointed out that locomotives subjected to the water test showed leaky superheater units in the front end, when no report of this trouble was given by enginemen. Stress was placed on the counterbalancing of locomotives as affecting the rapid wear of parts and hence reducing locomotive availability. It was stated that all new wheels should be carefully counterbalanced at the shops when applied and not main wheels alone. The question of self-adjusting driving box wedges was brought up and one member stated that an experience with 400 engines equipped with this type of wedge on his road showed that uniform adjustments for all classes of power is impossible, but that the adjustments must depend to some extent on the class and severity of service. Another important consideration is the kind of material used for the wedges. Cast iron or steel will gall when bearing against steel, which is not the case with a brass to steel combination. Consequently on this road the brass face or floater has given the best results with self-adjusting wedges which have demonstrated their value for heavy power.

Developing railroad shop foremen*

What type of man makes the best leader?—How many railroads have trained their supervisors?

By F. H. Becherer

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THERE is not a question of more vital importance in the railroad world today than that of developing foremen. In the past this has not been given that prominence which the seriousness of the situation justified. However, in recent years it has been the subject of considerable discussion, and executives are using the many available agencies at their disposal with a view of strengthening and building up this important feature of their personnel.

One of the reasons for this is that the foreman is the last connecting link between the management and its workmen and forms the keystone in the arch supporting the entire organization. Foremen act as liaison officers between workmen and higher officers, interpreting the

* From an address delivered at the International Railway General Foremen's Association convention held at Chicago, September 7 to 10, 1926.

policies of the management to the men and the men to the management. In doing this they perform what is most essential, outlining and explaining to each side the reasons of the other with a view of developing and fostering a better, broader, mutually sympathetic understanding of each other's problems. It has been demonstrated that the morale of the rank and file of employees can be and is influenced to a large degree by the thoughts and actions of their supervisors. Consequently it is of the utmost importance that they understand the various phases of their responsibilities and possess the qualifications, breadth of vision and ability to measure up the situation.

Another reason is that the revenues of the railroads in the past few years has not kept pace with their expenditures. In order to exist and operate their properties on a sound business basis, the railroads must of necessity reduce their operating expenses. This can only be accomplished by effecting various economies, through the agency of foremen, of labor saving devices, new machinery, by using their present facilities to better advantage by a re-arrangement of work and by procuring production of a better quality and quantity; to obtain increased mileage between shoppings on their locomotives and to lengthen the periods of shopping on freight and passenger equipment, securing at the same time a decrease in the number of train detentions due to equipment failures.

To a large degree the success in obtaining the desired results, is predicated in direct proportion to the ability of supervision, not however, losing sight of the fact that the skill and ability of the individual workman is of great importance. The efforts of the best workman, however, can only reach their full effectiveness when guided and co-ordinated by skilled and competent leadership.

Selecting future leaders

It has often been said that foremen are born, not made, and to a certain extent that is a fact. The man who has been studying character is enabled to pick out the natural born leaders. Inasmuch as some must be made, the time to start is when they are employed as helpers and apprentices. The employing officers should be capable of selecting from among the applicants for employment those who in his opinion possess the qualifications and attributes necessary for leadership, and call these to the attention of the officers for systematic training which will be outlined later.

The general foreman should confer with the foreman under whose direction those so selected are working; he should whenever going through the shop, talk to these men with the idea of obtaining their viewpoints on the fundamental principles. It should not take long to determine whether or not the judgment of the employing officer is correct. After the workman has served his required number of years and has demonstrated his ability, an excellent plan is to assign to him a piece of difficult work or some disagreeable task and check his reactions. A few instances like this should enable one to determine whether he possesses the required ability and stamina to be considered further. If the reaction is satisfactory when a position of leading man is vacant, the foreman in that department should be requested to make a selection of two or three whom he desires to be given consideration. The workman so selected should be called before the foreman and general foreman and pass an oral examination to demonstrate his knowledge not only of the particular work to which he will be assigned, but with a view of determining his ability to grasp the human relation problems and his ability to handle men. After the appointment to leading man has been made he should be advised and assisted. Whenever he makes a mistake it should be explained to him and he should be shown how it could have been avoided. Whenever possible, he should be asked for an opinion on various subjects; in other words, a little deference should be shown him while he is a foreman in embryo, as it is essentially important that he be prepared to fill the higher position when vacant. At times when the foreman is absent, naturally he will fill the position. On these occasions he should be under observation to determine his capabilities for further advancement.

It is my opinion that the finest basic training a man can obtain is through an apprenticeship system. The road which has already instituted apprenticeship training for its mechanics possesses a valuable asset in that it can procure from among these graduates, men who are naturally endowed with the necessary qualifications for leadership. Some roads select these men, also men of mechanical ability from among mechanics and leading men in car and locomotive departments, and promote them to special apprentices, giving them the benefit of a year or two of intensive training, after which they are assigned to special duty. Experience has demonstrated the fact that they are particularly desirable as supervisors due to the training they have received.

In the selection of men for supervisory positions the opinion of the man to whom they are to report should play an important part in the selection, and appointments should never be made without that officer's full consent, as nothing will disorganize the supervisory force quicker than to show favoritism and promote a man without the knowledge or consent of his immediate superior,—in shop parlance, "going over his head." We look to foremen for results and we should not tie their hands by assigning to them, particularly in minor supervisory capacity, men whom they do not believe competent.

Staff officers should from time to time call the attention of the proper officers to those workmen who, in their opinion, are capable of receiving promotion. Many a man so selected has proved to be a veritable find, and when promoted has demonstrated his ability to fill the position to the utmost satisfaction. On some roads staff officers are instructed to report to the mechanical superintendent when they discover men of exceptional ability, filling minor positions, in out-of-the-way points, where in the natural course of events they would not come to the attention of the appointing officer.

The essentials of a foreman

Essential qualifications which the prospective foreman should possess to be successful are tact, self-control, fairness, persistence, industry, loyalty, honesty, initiative, and good judgment of human nature. He should have a fair education: at least that of a public school and, preferably, a high school. If a college graduate his advancement will be more rapid. Obviously, he must thoroughly understand the work, and if necessary, possess the ability to show the new workman how to accomplish it with least physical effort and at the same time secure better quality and quantity.

Tact or diplomacy is that delicate skill in saying or doing what is expedient in the many situations that arise. Properly used, it acts as an oil on troubled waters. Self-control is an absolute necessity, it can be cultivated to a certain degree, but the foreman who can not control his anger soon loses the respect of his workmen. The supervisor who is fair and just rarely encounters embarrassing situations, he never decides until he has heard

both sides of the case, never uses snap judgment, does not show partiality or favoritism, and when he makes a promise, always keeps it. Persistence is that "stick-to-it-ive-ness" spirit, from the vocabulary of the possessor of which the word "cannot" has been eliminated, and the phrase "will try" substituted. He goes slow, is sure he is right, and usually wins his point.

A drone will never be a leader but the man who is industrious cannot help but gain and maintain the respect of all who are associated with him. Loyalty is one of the prerequisite traits. The supervisor who supports his superior officer and is loyal to the company which employed him must succeed. Some faults can be overlooked but disloyalty to my mind is one of the cardinal sins and cannot ever be condoned. Honesty is that pearl of virtues. It does not permit of "buck passing." When asked a question the foreman always answers it truthfully, even though he sometimes places responsibility upon himself. Initiative is that attribute which enables a man when placed in difficult places to study the problems and plan how to surmount the obstacles.

Now we come to that qualification which is an absolute necessity—ability to judge human nature and understand the problem of human relations. The day is past when a man's ability as a foreman was measured by his capacity to drive men, one whose every sentence was interspersed and punctuated with profanity. Eliminating the use of profanity by foremen marked the dawn of a new era as the supervisors of today when issuing verbal instructions, or giving orders, do so in a manner which leaves no room for doubt that they are to be obeyed. However, these orders are given in language which commands the respect of employees to whom they are given.

What some roads have done in training foremen

Methods used in the training and development of foremen have undergone a decided change during the past few years. The old system of promoting a man, then leaving him to his own resources to work out his problems has been abolished. Those selected are now given systematic training from the time they enter the service. Practically every road has instituted some form of developing foremen. Many of the larger roads, realizing the importance of this phase of the work have authorized certain expenditures so that the instructions can be carried on systematically. Several eastern roads, among them, the New York Central, New York, New Haven & Hartford, Delaware, Lackawanna & Western and Boston & Maine, have appointed men in charge of personnel. Part of their duties is to co-ordinate the educational work on their properties and under their direction this intensive training is given, not only to prospective supervisors but to those already filling these positions.

Several methods are used; some roads utilizing all and others only a portion. In the main, however, they may all be grouped under four major headings; the lecture, text pamphlet study, conference, and university extension methods.

Under the lecture may be classed foremen educational clubs, and staff meetings. The practice usually followed in foreman's clubs is to select for the topic some subject which is a very live one due to the fact that it has been the cause of detentions to trains en route on account of locomotive or car failure or the men, sometimes the mechanical officer in charge, has felt the necessity for increased knowledge on the part of the foreman on that particular subject. A paper is prepared by one of the staff officers or general foreman who has previously been selected on account of his expert knowledge of the subject. After the presentation of the paper the subject is opened for general discussion. The establishing of this open forum, and the sometimes heated discussions which ensue only tend to make them the more interesting. These meetings provide a common ground upon which everyone is invited to express his opinion, to present for discussion certain information, or request a correct solution of problems pertinent to the subject which had arisen in his daily work. The discussions which ensue have proved to be of inestimable value to the supervisors and to the railroads.

Staff meetings are a positive necessity. The railroad officer who does not hold them is not giving his subordinates the proper instruction. It is at these monthly, weekly, or daily meetings that he should impart to his staff the information which he wishes placed before his foremen and they in turn to the rank and file. On these occasions questions of policy are brought up for discussion and the information obtained from the staff is of the utmost value not only to those present but also to the management. The range of subjects discussed is extremely valuable in the development of foremen, giving them an insight into the proper use to be made of records, instructing them how to analyze and compare statements, how they are used for comparative purposes and the influence which they exert on future policies.

The text pamphlet method of developing foremen is widely used by a great many railroads. Pamphlets or booklets are prepared by the various staff officers, and sent out to the foremen covering subjects over which they have supervision. In some cases these pamphlets are also given to prospective supervisors, and in a few instances to the men. After a sufficient time has elapsed to enable those to whom they are given to have thoroughly studied them, a series of questions is given, sometimes written and sometimes oral, with the idea of determining how much of the subject has been absorbed. This method is also supplemented by various educational bureaus which prepare these pamphlets and sell them to all of the employees, regardless of their position, and are a valuable asset in the developing not only of foremen but of the rank and file. Some roads in order to encourage this effort on the part of their employees co-operate to some extent with these bureaus, and permit their employees to pay for these courses by having a certain amount deducted from their pay. In some cases, of course, the employee's intentions are excellent at the start, but due to lack of effort, and industry, they are not completed. The men in these cases are certainly undesirable as supervisors.

Another one of the practices instituted on numerous roads is the daily shop meeting or conference. This is attended by foremen of all departments, the local storekeeper or his representative. They are usually held in the morning around nine o'clock consuming from 10 to 30 minutes. Subjects brought up for discussion are material, schedules, production, safety, changes in policy, locating and eliminating delays, planning for daily production. These meetings are of immense value to the foreman as they inculcate in him the spirit of team work and co-operation.

Outside influences valuable

The vast majority of roads send their staff officers and foremen to the various conventions, one of which is the International Railway General Foremen's Association convention.

I cannot lay too much stress on the opportunity within the reach of every supervisor and prospective super-

visor, and that is his ability to procure such technical magazines as Railway Age, *Railway Mechanical Engineer*, Railway Journal and Railway and Locomotive Engineering. The importance of these publications has long been recognized by the railroad managers who have subscribed to them in large numbers, to be sent to their various officers. These publications are always available to those who indicate a desire for self-improvement. The articles appearing in them are of valuable assistance to the man looking for improvement and advancement. Not long ago I was intensely interested in a discussion appearing on one of them as to the benefits derived from reading the advertisements. At this time I want to state that the man who does not read them is not keeping up with the times.

A few weeks ago one of the departmental superintendents wrote a letter to his staff calling attention to an article appearing in one of these magazines, asking for comment. The replies received showed that his men had noticed and read it and from the wide diversity of opinions obtained, indicated that they were not the so called "yes, yes," or rubber stamp variety.

Permitting your supervisors to visit other shops on your own road and shops on neighboring roads is of valuable assistance. A few years ago a committee of three on an unmentioned road were appointed to procure information relative to installing a piece work system. They spent ten days covering several different shops on various roads. The good points of all the systems were incorporated in their own. Should you ask the mechanical superintendent of that road if the information obtained was commensurate with the expense involved he would tell you that they were still paying dividends on the original investment.

Colleges recognize the importance of the work

Within the past few years a new avenue of instruction has been opened up to the foremen. State universities of several states with aid of the Y. M. C. A. have organized classes;—in some cases of foremen and in others of mechanics. Notable examples are the University of New Hampshire, University of Michigan, Rutgers University, Massachusetts Institute of Technology, Pennsylvania State College, Iowa State College and others.

Quoting R. V. Wright, editor of the *Railway Mechanical Engineer:* "They must be conducted under strong and efficient local direction and have properly equipped leaders," and I would add, the earnest desire of the individual for self-equipment.

In recent years we have often heard the expression that the opportunities for advancement on railroads do not exist as they formerly did. It is my opinion that the opportunity within the reach of every individual railroad worker far surpasses the opportunities or avenues for education which were open to railroad men of the last decade. University extension work is yet in its infancy or experimental stage. It will continue to grow and I believe that within the next few years we will see a well defined college course for foremen, outlining the subjects which the railroad men of today find so necessary.

Co-operation with other departments necessary

One phase which has seriously interfered with the development of the foreman has been the lack of instruction regarding the relation of his own to other departments. Much stress is now being laid on this phase of the situation, and it is particularly noticeable in the suggestions given before railroad foremen's clubs. In one of the editorials appearing in the *Railway Mechanical Engineer* the question is asked " 'Why is it that more car men do not succeed in reaching the higher executive positions.' If there is one reason more than another it is because they become too engrossed in the details of their own special work to see how best to co-ordinate their efforts with those of other departments, how best to develop the breadth of view which is absolutely essential to the successful railroad executive officer."

We believe that there is just as much available timber in the car and locomotive departments as there is in the operating department. The essential thing is an opportunity for the broad visioned, hard thinking man of these departments, and there is no question but what he will succeed.

A successful foreman must understand his men

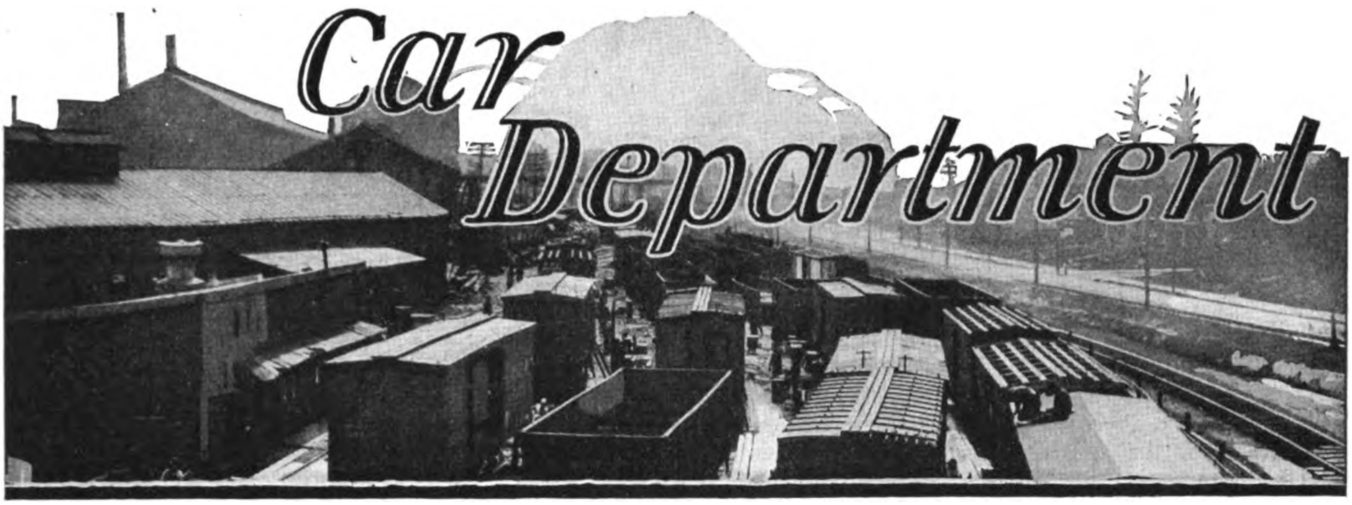
The foreman has under his immediate supervision the three M's, material, machines and men. Of these the most important is men. Regardless of what excellent facilities a shop may possess, as to modern buildings, equipment and machinery, if a foreman does not thoroughly understand the men placed under his care, he can never hope to obtain that degree of success for which we are all striving. It does not entail any expense or unusual effort to become interested in the things which are close to the hearts of his men. There is nothing which will gain the universal admiration and respect of all his men more rapidly than to show an interest in that which is most dear to them, and that is, their family. When sickness, death, or trouble enters a home, a word of inquiry or consolation with such aid or advice as can be given, goes a long way towards demonstrating to his men that he is not only interested in them for the work which they perform but in their personal welfare. It is surprising what large dividends are paid by efforts so expended.

Previously I have stated that I would give you some of the results obtained on various railroads from foreman's training. On one road a large portion of the credit is due to the intensive training given their foremen, which has resulted in an increase of 100 per cent in the mileage of locomotives between shopping. It has resulted in an increase of 600 per cent in production in individual cases. On the same road it has resulted in a decrease in locomotive failures from 1,900 per month in the year 1923, to 140 per month in 1926. On another road there has been a marked decrease in the detentions to trains en route due to locomotive and car equipment failures.

It would be possible to elaborate on this to a great extent but I believe these few instances will tend to demonstrate to you the results obtained from the extensive training given their foremen.

Comparison of 10-coupled locomotive types—A correction

ATTENTION has been called to an error in the table of examples of recent locomotives of the 2-10-0, 2-10-2 and 2-10-4 types published on page 481 of the August *Railway Mechanical Engineer*. The Texas & Pacific 2-10-4 type should have been shown as a limited cut-off locomotive; the coal rate, lb. per sq. ft. grate per hour (Cole) and the steam rate required per hour, lb (Cole), which are based on full stroke cut-off, should have been disregarded as was done in the case of the Pennsylvania limited cut-off 2-10-0 type locomotive.



Car inspectors' association changes its name

Silver anniversary of first convention notable for broad treatment of important car problems

On the twenty-fifth anniversary of its founding the Chief Interchange Car Inspectors' and Car Foremen's Association of America convened at the Hotel Sherman, Chicago, September 21, 22 and 23, and exhibited a firm determination to capitalize on the inspiring history of the association as an incentive to still greater achievements. The convention was notable for the earnest discussion and broad treatment given to important car problems, particularly as relates to the efficiency of the railroads as a whole, and at the closing session it was decided that the association can best serve its purpose and increase the scope of its work by changing its name so as to encourage and promote membership by car department supervisory officers of all ranks. It was accordingly voted that the Chief Interchange Car Inspectors' & Car Foremen's Association of America be hereafter known as the Railway Car Department Officers' Association.

The total membership of the Railway Car Department Officers' Association is now in excess of 1,300, about 400 memebers being in attendance at the Chicago convention. Following the usual opening exercises, an inspiring address was made by R. H. Aishton, president of the American Railway Association, who eulogized the work of the association and closed with the following comments on its future possibilities:

"In summing up, I might say, that the proper carrying on of all of your work as it ought to be carried on has a tremendous effect in many ways. It means less loss of life and limb of trainmen, greater car mileage, fewer accidents, less destruction of property and equipment, less repeated shopping of equipment, greater available car supply at all times, less need for the purchase of new equipment, decreased cost of operation and maintenance, more prompt handling of business resulting in greater satisfaction to shippers and better earnings for the railroads. What better goal could you work to than this?"

The association was addressed by President W. P. Elliott, general foreman, Terminal Railroad of St. Louis, and then Joe Marshall, special representative of the American Railway Association, discussed the progress of work in freight claim prevention. The subject of handling explosives and other dangerous articles was presented by E. J. League, representing Col. B. W. Dunn, chief inspector of the Bureau of Explosives. Individual papers were presented as follows: Handling Wheels and Axles at Wheel Shops by W. P. Westall, assistant district master car builder, New York Central, Toledo, Ohio; the Trouble of the Small Interchange Points by John Rauscher, chief interchange inspector, Cincinnati, Ohio; Preparation of A. R. A. Billing Repair Cards and Record of Repairs Simultaneously at the Car by C. C. Hennessey, chief A. R. A. clerk, Cleveland, Cincinnati, Chicago & St. Louis; Progressive Rebuilding of House Cars by C. M. Hitch, district master car-builder, Baltimore & Ohio, Cincinnati, Ohio; and Reduction of Transfers at Large Terminals by C. J. Nelson, chief interchange inspector, Chicago. The usual animated discussion of A. R. A. Rules of Interchange and interpretations of the Question Box committee, were participated in by many of the members in attendance.

Election of officers

The following officers were elected for 1927: President, B. F. Jamison, special traveling auditor, Southern, Meridian, Miss.; first vice-president, E. R. Campbell, chief interchange inspector, Minnesota Transfer, St. Paul, Minn.; second vice-president, M. E. Fitzgerald, general car inspector, Chicago & Eastern Illinois, Danville, Ill.; third vice-president, W. R. McMunn, general car inspector, New York Central, New York City; A. S. Sternberg, master car-builder of the Belt Railroad of Chicago was re-elected secretary-treasurer.

Four new members were elected to the Executive Committee: C. J. Nelson, chief interchange inspector, Chicago; M. P. Cole, general car inspector, Boston &

Maine, Boston, Mass.; E. D. Colon, shop efficiency engineer, Pere Marquette, Detroit, Mich.; and H. J. Smith, general car inspector, Delaware, Lackawanna & Western, Scranton, Pa.

One feature of the convention greatly appreciated by the membership was the moving picture shown in connection with Mr. Westall's paper on wheel shop work. This moving picture, taken by W. H. Miner, Inc., Chicago, and shown through the courtesy of that company, aided materially in visualizing the principal points brought out in the paper.

Another feature of the convention was the inspirational talk by F. W. Brazier, assistant to the general superintendent of rolling stock of the New York Central, at New York, who has taken a kindly and helpful interest in the association almost since its founding.

Abstracts of the addresses, papers and reports presented at the convention will appear in this and subsequent issues of the *Railway Mechanical Engineer*.

President Elliott's address

Some system must be devised that will eliminate, if possible, the unnecessary transferring of cars, and I recommend that this subject be thoroughly discussed by the association in order that we may go on record with suggestions that will be acceptable to the arbitration committee.

A number of railroads have associated themselves together with the understanding, that if a car with a transferrable defect is safe for movement or can be made so with temporary repairs, it may be allowed to proceed to its connecting carrier, transfer authority being issued by the original delivering line should subsequent transfer prove unavoidable. A large number of cars have been handled under this agreement, demonstrating that it has been beneficial not only to the railroads but to the public and shippers as well. If all cars were of foreign construction and equal to the ordinary handling in classification yards and heavy train movement, such arrangement possibly would not be necessary. It is unfortunate, however, that due principally to the various types of equipment construction, many of them weak in design, with the handling line not able to make repairs for the want of parts, transfers must be made.

Visits to many large terminals and exhaustive inquiries indicate that the majority of the railroads at these large terminal points are not properly equipped with facilities to make necessary repairs to cars either under load or empty. This is one important cause for the continuous transfer of equipment.

It is the hope that through the work of the Arbitration and Price committees, after giving due consideration to the present situation, prices for labor and material will be made adequate in order to encourage the handling lines to maintain foreign equipment. Under the present status, the tendency of the handling line is at all times to move the car homeward over some other connecting carrier.

Equipment should be inspected prior to being loaded, particularly, at industries on these various lines. It has been my observation that at large terminals, inspection is made more thoroughly than at outlying points where possibly no inspectors are engaged, thus contributing to delay of cars en route, either on account of repairs or transfer.

Today we are giving closer attention to air brakes than ever, which is contributing largely to the splendid car mileage per day being made. I sometimes wonder if we are giving similar attention to the hand brake. Our one source of trouble in the past has been worn brake hangers, brake hanger pins, etc. It is my opinion that these conditions are more due to vibration than actual wear from brake operations or carrying the brake beams. Most modern cars are equipped with modern devices which steady the brake beam and reduce this vibration to a minimum. Our forces should be trained to maintain these devices in their higher state of efficiency.

Brakes properly maintained protect train movement. Friction draft gears properly maintained protect switch movement at terminals. We have set periods for inspection and repairs to brakes, journal boxes, etc., which is the reason that we obtain safe and efficient operation. It is my belief that we can set up similar rules for the inspection and repair of draft gears to insure their safe and efficient operation and a minimum damage to equipment and commodities in switching service.

Friction means wear and it is no more reasonable to expect friction draft gears to go on indefinitely without wear than to expect air brakes to function without wearing the brake shoes. I would suggest that this important subject be handled by a committee to make recommendations at the proper time.

In my opinion much good will result if a local assosiation of our membership will function at each large interchange center. Our membership, being composed exclusively of supervisory car department officers, would enjoy every confidence of the railroads at these centers, and local conditions could be discussed at meetings held several times during the year, matters of national importance being brought to the attention of the annual convention. I believe this will work much to the advantage of the association and would place in all large terminals a body of men on whom the Arbitration committee could call for advice regarding local conditions.

Resolutions offered by C. J. Nelson

The question of rebuttal transfer, or agreement by one road to move cars with transferable defects not militating against safe operation, provided it is guaranteed against loss should subsequent transfer prove unavoidable, was in dispute among the members of the association. The set of resolutions, however, offered by C. J. Nelson, chief interchange inspector, Chicago, as the solution to the whole transfer problem met with practically the unanimous approval of the association. These resolutions are as follows:

1—That selfish interest be avoided to the best advantage of the railroads as a whole, and their patrons, with the predominating policy of united efforts to forward all loaded cars to destination without transfer.

2—That the maximum efforts be made to maintain freight cars in sufficiently good condition to carry their loads to destination.

3—That efficient and systematic inspection of cars be required to prevent the loading of defective cars which may have to be repaired, or may require transfer of loads before reaching destination.

4—That every practical effort be made to have cars repaired underload, but in the event repairs cannot be made underload, permit cars to go forward, provided, of course, they are safe to handle in road trains.

5—That loaded cars found with defects that render them unfit to carry loads to destination should not be offered in interchange, but should be repaired or transferred by the handling road with the understanding, however, that when once delivered they should not be returned.

6—That if a defective car is safe to carry its load to destination, the fact that it might be transferred before reaching destination on account of conflicting opinions, that it might be necessary to place it on the repair track after it has been unloaded at destination and perhaps wait for material from the owner, or that it might be necessary to return it home empty, should not be taken into consideration in deciding whether or not the load should be transferred.

7—That in the event it becomes necessary to repair a car, or transfer its load before it reaches destination due to defects that apparently existed when the loaded car was previously received in interchange, utmost care should be exercised in deciding whether or not the judgment of the men who allowed the car to go forward was at fault, in order to avoid unfair criticism which invariably has the detrimental effect of causing men to become unduly technical.

Loss and damage

By Joe. Marshall

Special representative, American Railway Association

Using round figures, last year the loss and damage bill of all railroads was 36 million for the United States and two million for Canada, or 38 millions. About 88 million dollars have been taken off the loss and damage bill during the past five years, and with this money you could pin a twenty dollar bill on every man, woman and child in Cook County, Illinois, and have a lot of money left.

The work on the loss end of the loss and damage bill has advanced to the point where the principal attention is now being paid to damage, with particular reference to carload freight. If we include delay, this item will represent 63.3 per cent of the total paid.

There are about 130,000 car men in service and they wield an important influence in the work of handling freight safely.

The car repair bill for the United States in 1924 was $380,925,734 or 8.4 per cent of the total railroad expense. In Canada it was $28,298,158 or 7.5 per cent. The loss and damage in that year was $41,262,583 or .8 per cent of the total expense for the United States and $2,254,812 or .6 per cent for Canada. I am giving you these 1924 figures in order that a comparison may be made since 1925 car repair figures are not as yet available.

It has been estimated, from reliable studies, that about 3 per cent of the car repairs can be charged to rough handling of equipment in trains and yards. If this estimate is fair we thus can add 11 million dollars to the United States claim account and 850 thousand dollars to the Canadian account, and in that manner provide a larger field for results in reducing this expense.

You are interested in defective equipment. The highest sum paid on this account in any one month was $1,050,268 in April, 1921. The lowest sum was $263,390 in November, 1925, and that was 29 thousand less than the average paid per month in the year 1914 when we were doing less than half the business we are doing today.

Here are the principal items in 1925:

	Commodity	Carload	Less Carload	C.L. & L.C.L. Total
9	Grain	$1,313,860	$5,495	$1,319,355
24	Coal and Coke	751,938	5,959	757,891
10	Flour and Mill Products	341,953	12,695	354,648
35	Miscellaneous Commodities	336,912	26,826	363,738
5	Fresh Fruits and Vegetables	162,940	3,418	166,358
11	Sugar	148,554	3,075	151,629
25	Lumber and Forest Products	76,342	1,564	77,906
23	Cement, Lime and Plaster	69,077	1,823	70,900
20	Iron and Steel Products	38,966	2,578	41,544
6	Live Stock	36,075	151	36,226
12	Groceries	25,024	3,706	28,730
	Total	$3,301,641	$67,290	$3,368,925
	Total of all commodities	3,462,939	106,255	3,569,194
		$161,298	$38,965	$200,269

$3.569.194 was paid on defective equipment in 1925; this is 9.2 per cent of the total and it divides as follows:

Grain, carload	36.8 per cent
Coal and coke, carload	21.0 per cent
Flour, carload	9.6 per cent
F. Fruits and Veg., carload	4.6 per cent
Sugar, carload	4.2 per cent
Less-than-carload freight	3.0 per cent

Defective equipment is a matter of selection of the car best suited to the commodity it is to carry, and with comparatively few exceptions you will have no difficulty in any yard in finding the few good cars required for the comparatively few high-grade commodities, highly susceptible to damage when an improper car is used. Using high spots I find these high-grade cars would number approximately four million and eight million for low-grade, meaning coal, out of 51 million cars loaded last year. At a pinch, consider four million for the high-grade or 8 per cent. If we play on this 8 per cent we can reach 55 per cent of what is paid on defective equipment and if we add the coal cars we can get another 21 per cent.

Classified commodity card system helps

It has been shown that we can always find sufficient cars to serve our high-class commodities, especially when a good classified commodity card system is in effect. One road has found this true in large terminals, they have a man assigned to this work who applies cards to cars loaded by local as well as foreign line industries.

Your help in the rough handling campaign can come through the means of using the facts you develop in the car department when repairing cars. For example, one road reports 16 couplers removed from certain cars. Here is what they found:

3 shortened 1 in.
2 shortened ⅞ of an in.
3 shortened ¾ of an in.
4 shortened ½ in.

all the balance shortened anywhere from ¼ to ½ in. and all of them shortened, or upset cold, by impact. This is good stuff to present to those who handle cars; it is unanswerable proof.

In another case, check of coupler failures showed:

Inherent defects	50 per cent
Rough handling	30 per cent
Train parting	20 per cent

In another case, a check of bad order transfer showed this:

Old defects	60 per cent
Failures to note defects when loaded	10 per cent
Rough handling	20 per cent
Accidents	10 per cent

Another check of a number of cars transferred showed this:

Sills split and broken	40 per cent
Bolsters broken	29 per cent
Truck side and frame	19 per cent
Draft arm and channels	12 per cent

These are the examples or the proof the car department can present to local meetings of railroad men in order to sell the idea that these things result from handling and to the degree that we can ease our handling, to that degree we will save expense, labor and trouble to all the departments that must clean up the bad effects produced by mishandling, or waste of any nature or description.

Today delay payments result from individual cars getting into trouble and not to slow movement of train. A test for two weeks made at two terminals shows 500 cars cut out of trains on account of bad order; this not only delays the car, but delays the trains, so the subject is of double importance. Don't cut cars out of trains on account of bad order if there is any way to avoid it. Repair them in the train if possible. If a car is cut out, special efforts should be made to see that trains are not run around it.

Suggestion in connection with blue flag rule

We have another example here of OPPOSING FORCES that sometimes apply in connection with delay. Take the blue flag rule for example. Of course

no one wants to unload the blue flag rule, but we have trains twice as long as we had when this rule went into effect, so we ought not to have a yard crew waiting if we can find a way to shift the flag and give them part of the train to work on while the car man is working on the balance. In order that you may have something in your proceedings to show the high spots in delay, the big end of which is fresh fruits and vegetables, I will quote some high spots developed in an analysis of 1926 fresh fruit and vegetable claims amounting to 162 thousand dollars, by a committee of the Eastern Claim Conference:

Engine failure	12.4 per cent
Passenger train interference	9.0 per cent
Wreck	1.3 per cent
Defective equipment	7.9 per cent
Icing and classification	9.3 per cent
Congestion	30.0 per cent
Diversion orders mishandled	.7 per cent
Improper notification	1.1 per cent
Miscellaneous	28.3 per cent

By departments this divides as follows, for the road 60.6 per cent, for the yards 18.8 per cent, for the terminals 20.6 per cent.

We still have cases where cars are loaded and must go on the rip track for defects even before they can get out of town, which means a 24-hour delay. Any car under load which can be repaired in yard or in train without placement on rip track will help greatly in the delay account, also it is an easy thing for a car to become two or three days old after it misses the first sitting or repair track and then more delay may follow in digging it out. We think much of our delay money now goes to the car which gets into trouble and further reduction will depend upon the extent to which this feature can be supervised.

By the very nature of his work the car man is a natural prevention man, he is a builder, and as a builder he is opposed to waste of any kind, and he is the strongest force in this respect the claim and claim prevention man can find in any branch of the railroad service.

Operation of wheel and axle shop

By W. T. Westall

Assistant district master car builder, New York Central, Toledo, Ohio

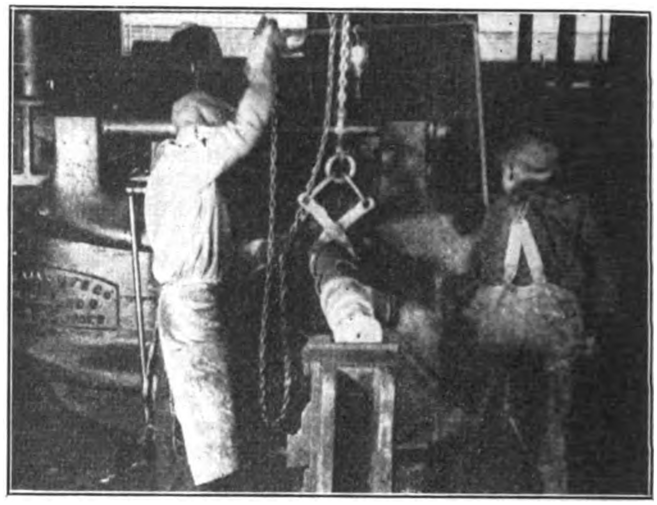
Cars with incoming scrap wheels and cut journals for demounting and truing, are placed on an industrial track, within reach of an overhead traveling air hoist which spans four tracks. A double rail scrap storage track and two double rail storage tracks for serviceable mounted wheels are provided.

The two double rail storages for serviceable mounted wheels are 271 ft. long, and will hold 160 pairs each, the rails being so spaced that journals cannot be damaged. These tracks are elevated at the cross industrial track, and slope toward the air hoist where loading is done, so that the wheels move down by their own weight. The double rail scrap storage is elevated below the air hoist so that the wheels move toward the wheel shop in the same way.

As the wheels are unloaded by the stores department the same cars are reloaded with new or second-hand serviceable wheels. Eight cars can be handled without further engine switching, by means of a block and pulley secured in a concrete foundation with a chain to an air hoist piston and the car truck.

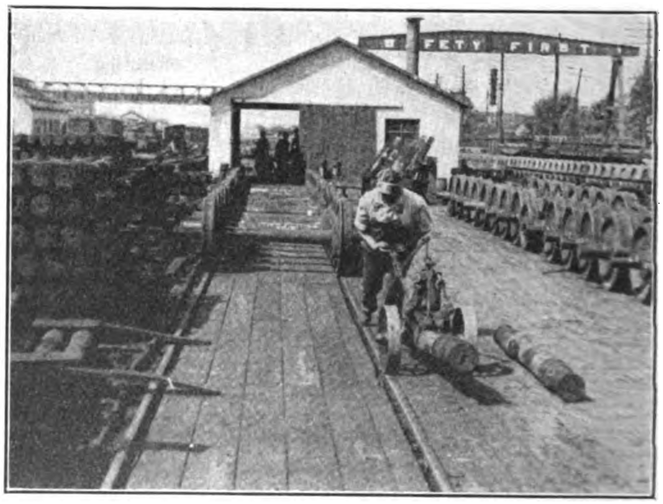
Each wheel and axle is marked as it is removed from a car showing the date and defect by code numerals stenciled on the back of the flange as follows: *0*-worn tread; *1*—shelled out; *2*—brake burn; *3*—seamy tread; *4*—worn flange; *5*—worn through chill; *6*—slid flat; *7*—broken hub from pressure; *8*—chipped flange; *9*—chipped rim; *10*—cracked plate; *11*—cracked bracket; *12*—seamy journal, *1-28*—cut journal *2-28*—bent axle; *3-28*—long journal; *4-28*—loose wheel; *28*—OK for remounting. As these wheels are received at the wheel shop for dismounting, a report showing the list of defects is forwarded to the wheel shop foreman.

The shop wheel inspector checks all wheels and axle



Worn axles are set in Ajax forging machine in four operations: First and second, squeeze dust guard seat; third and fourth, form new collar

defects with these records and in this manner any defect that might be overlooked by the points forwarding the wheels or any changes to be made are corrected, and the originals returned to the shipping point for correction of the records. Wheels that have failed to make the guarantee, wheels for test, broken-off journals and all defects which may have caused derailments and delays



A special two-wheel truck facilitates handling axles

are then stenciled "HOLD FOR FINAL DISPOSITION."

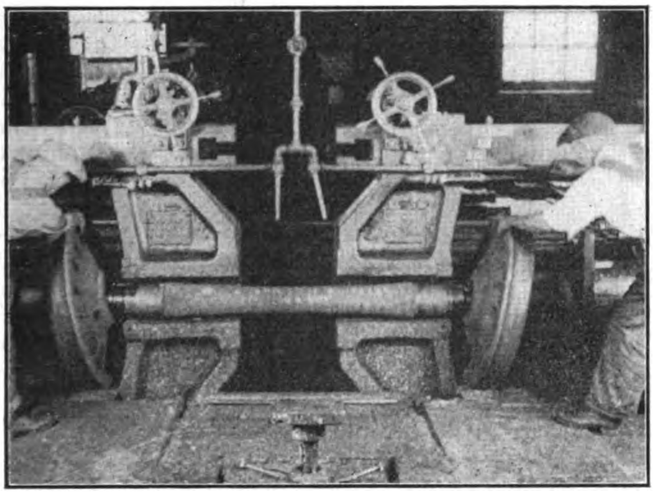
All axles for turning, and the scrap axles for upsetting are delivered to storage piles in front of lathes by one press man by means of an air hoist and overhead trolley.

Scrap axles not suitable for upsetting are taken out of the shop by laborers, chipped by them and marked steel or iron by the foreman. Axles are then loaded on

an axle scrap car placed at the end of the wheel shop on depressed track, and disposed of as sales orders are received. Scrap axles for upsetting are handled through the lathes as they come off the press, and on the 5-in. by 9-in. size, collars are turned off and journals turned down to 4 13/16 in., this being the largest size that can be handled on this forging machine, hence the necessity for turning off the collars.

Method of reclaiming axles

On axles with 5½-in. by 10-in. journals, the collars only are turned off and the axles shipped to other points



Two wheels are removed at a time in the 400-ton Niles double-acting car wheel press

having larger forging machines to be upset to 5-in. by 9-in. size or 80,000 lb. capacity. After turning, the axles are taken to storage piles between the wheel shop and blacksmith shop for upsetting in the forging machine. The axles are placed in a furnace, the ends being heated to the proper temperature for upsetting. This work requires three to four operations per end, according to the worn condition of the journal or dust guard seats.

The first and second operation is the squeezing of the dust guard seat to decrease the diameter and increase the length. The third and fourth operation is the forming of the collar obtained by the increased length brought about by stretching.

The average output is about 60 ends or 30 complete axles per 8-hour day. Axles are then transported to the annealing furnace by means of an electric truck and trailer, unloaded on an elevated platform for loading on axle car which in turn is placed in the furnace.

Forty-two axles are placed in this furnace, spaced 3 in. apart on the car to allow for proper heating, which is between 1425 to 1475 deg. F., the heat being controlled by a Tycos pyrometer. The axles are held at this temperature for 6 hours, the furnace then being shut off and axles left to *cool in the furnace*. After cooling, the car is taken out to the elevated platform and axles rolled direct into storage piles.

Before going to the furnace for annealing, upsets are checked at the forging machine by an operator and foreman for the proper length over all, and the distance between dust guards, collar and journal diameter with gages designed for that purpose.

Axles for machining are taken from the storage piles inside the shop by means of air hoists and overhead trolleys, which are so arranged as to lift the axle to the proper height, and carry it central into the lathes. The size of the wheel seat diameters is stencilled back of the wheel seat with 1½-in. figures with white lead, and the operator's mark is stamped with a steel letter on collar of all axles turned.

The press output averages 90 pairs of wheels pressed on in 8 hours, or approximately 11½ pairs per hour and approximately 26 pairs pressed off; this includes oiling, changing of press, and removing axles that are fitted up from storage piles so that boring mill operators are not handicapped in their fitting.

Machine equipment in wheel shops

The machine equipment includes one double-end Niles car wheel press of 400 tons capacity, and 13-in. ram. On one double-end No. 3 Niles axle lathe, the average production in 8 hours is 20 second-hand axles, or 11 new, or 8 upsets turned complete, or forty 5-in. by 9-in scrap axles turned for upsetting. One double-end heavy-duty Putnam axle lathe of about the same average as the Niles is provided.

One single-end Bridgeford journal turning lathe is used for axle turning only, with a 10-in. way extension added. The output of this machine is 16 second-hand axles or 8 new axles finished in 8 hours or 32 scrap 5½-in. by 10-in. (collars turned off for upsetting).

One journal lathe (New York Central make) has an average output of 11 pairs of cut journals in 8 hrs.

One Putnam 48-in. car wheel borer, equipped with special Davis two-in-one boring bars, has an average output of 66 wheels in 8 hrs.

One Niles 48-in. car wheel borer has an average output of 68 cast wheels in 8 hrs.

The wheel shop organization consists of one foreman, one night gang leader having supervision over the night force in the blacksmith shop and fabricating shop, two wheel pressmen, two boring mill operators, four axle lathe operators, one journal grinder operator, three laborers.

Our machine operator force is familiar with either

New York Central wheel shop at Toledo, Ohio—Note inclined rails to shop—Depressed track beside shop facilitates loading and unloading wheels

lathe, boring mill or press work, so that when men are absent their places can be easily filled. Axle lathe and boring mill work is checked by the foreman for possible taper and faulty work daily. Boring mill chucks are checked and spindle wear taken up when necessary.

The men, especially in this shop, are cautioned daily about safe practices, as injuries brought about by wheel and axle work are usually of a severe nature and the men are compelled to use the greatest care in the performance of their work.

Framed instructions pertaining to the work being done

at that part of the shop are placed throughout the wheel room, so that workmen may easily refer to such items as: table of mounting pressure, sketch showing system of taping second-hand wheels, code numerals covering wheel and axle defects, instructions for operating Davis expansion boring bars, allowance in thousandths for tonnage, cast and steel wheels, car wheel and axle data excerpts from A. R. A. rules, etc.

Troubles of the small interchange point

By J. Rauscher

Chief interchange inspector, Cincinnati, Ohio

As I see this matter, the trouble at small interchange points, where there is no chief interchange inspector, is that there are too many cars transferred and freight delayed unnecessarily, which results in a number of claims being filed against the railroads, and, as you all know, the cost of the transfer of a car is a small item as compared to that of claims made afterwards.

My suggestion as to the remedy for this trouble is that the local officials at these points get together, look into the situation thoroughly and figure out and adopt some definite plan to meet the situation, at all times, of course, complying with the A. R. A. rules. Cars are held up at small interchange points for transfer or A. R. A. cards, and when demand is made for this authority there is nothing left for the delivering line to do but issue it, as the receiving line is the judge as to what it will run on its line.

Of course, at large interchange points, where a chief interchange inspector is employed the situation is different as there are, as a rule, local agreements covering a great many points that cause disputes at outlying small interchange points, and, the chief interchange inspector acts as an arbitrator between the lines in interest, makes decisions as to the responsibility of defects and if the receiving line does not want to run a car that the chief interchange inspector feels is safe to run without transfer, they have the right to transfer the car at their own expense. If they are not satisfied with the decision of chief inspector and feel that they have not been justly treated, they have the right to call the Standing committee to pass on the defects. However, the decision of the chief interchange inspector at this point has not been appealed from in a number of years.

To give you some idea of our work along this line at Cincinnati, I herewith submit our report for the month of June, 1926.

Number of loaded cars received	114,417
Number of empty cars received	93,618
Total number of cars received	208,035
Number of cars set out for transfer called on	360
Number of cars ordered transferred	181
Number of cars run under load	128
Number of cars repaired	51
Number of cars set out for adjustment and ordered adjusted	140
Number of cars set out for hot boxes and found with journals cut, A.R.A. cards issued	332
Empty cars called on marked out for return movement	195
Of this number, returned	97
Repaired	78
Run without repairs	20
Cars called on for clean out orders	94
Clean out orders issued for	87
Cars called on damaged as per Rule 32	67
Cars called on for slid flat wheels	26
Cars called on for joint evidence	6
Cars called on for fire damage	2

In addition to making decisions on cases of dispute, etc., between lines as to responsibility of defects, we call on the inspectors and instruct them regarding the A.R.A. wheel gage, and make inspection of cuts for defects overlooked by inspectors, and make inspection of cars for safety appliance defects, report them to the inspectors and foremen of the lines in interest.

In Cincinnati we have two assistants and it is our duty to visit daily the shop tracks and transfer tracks and inspect cars held and make decisions to settle cases of dispute between lines. We also visit the transportation yards with the inspectors in the local and interchange yards and give decisions on any cases called on there.

Repairing dump doors on the D. & R. G. W.

By Joseph C. Coyle

Several months ago the car shops of the Denver & Rio Grande Western, Denver, Colo., were repairing a series of all-steel coal cars of the type shown in the illustration. The job of repairing the bottom dump doors presented quite a problem. They were heavy to handle, but the repair work required their removal in order to be straightened and a reinforcement of angle iron applied to the under side.

After a little study it was finally decided to handle this work in the following way. The doors were removed by hand, placed on push cars and taken to a 15-ton pneumatic press where the kinks were pressed out. They were then placed on a long trestle made of two

An A-shaped trestle was used for the final assembly

4-in. by 6-in. beams placed parallel to each other and resting on horses about two feet high. Lengths of strap iron were screwed to the top of the beams so that the doors could be easily slid along the trestle from crew to crew. The first crew stationed along this trestle bored the holes. Each door was then slid along the trestle to the next crew who keyed on the reinforcing angle iron, etc. The remaining operations were performed as the door moved along the trestle until it was ready for the riveting or assembling gangs. For this operation, the doors were removed at the end of the trestle and placed on an A-shaped trestle like those shown in the illustration. This trestle is also made of 4-in. by 6-in. beams, bolted together. This operation completed the job and the doors were again placed on push cars by the labor gang and taken to the steel shop for replacement. The successful operation of this system helped to attain a shop production of 12 cars a day.

Master painters meet at Detroit

Reports indicate possibilities of greater economies in equipment painting through new materials and improved methods

THE fifth annual meeting of the Equipment Painting Section of the Mechanical Division, American Railway Association, was held at Detroit, Mich., September 14-16 inclusive, about 140 master painters representing American railroads being in attendance. At the opening session, addresses were made by F. H. Alfred, president, Pere Marquette, and S. P. Seifert, superintendent car department, Norfolk & Western. Both speakers emphasized the increasing responsibility of the master painter in developing methods and selecting materials which will economically protect railway equipment from the destructive action of the elements. Mr. Seifert pointed out the increasing tendency to give serious study to the technology of paint and particularly stressed the importance of thorough co-operation between the painter and the chemist in order that new developments in materials and their application may keep pace with the demand for new ways of protecting modern railway equipment.

In addition to the members of the Painting Section there were in attendance at the convention, representatives of 54 manufacturers of painting materials. Arthur Orr of the Commercial Solvents Corporation presented an extremely interesting paper on lacquer finish. The increasing use of lacquer for finishing cars and locomotives has created a great deal of interest on the part of those responsible for the painting of railway equipment. In the discussion of Mr. Orr's paper, many pertinent facts were brought out. An abstract of this paper, together with a summary of the discussion, will be published in a later issue of the *Railway Mechanical Engineer.*

Election of officers

The following officers were elected to conduct the affairs of the Equipment Painting Section for the year 1927. Chairman, James Gratton, general foreman painter, Buffalo, Rochester & Pittsburgh, DuBois, Pa.; first vice-chairman, F. E. Long, foreman painter, Chicago, Burlington & Quincy, Aurora, Ill.; second vice-chairman, L. B. Jensen, general foreman, passenger department, Chicago, Milwaukee & St. Paul, Milwaukee, Wis. The following members were elected to serve on the Committee of Direction during the coming year together with six other members provided according to the regulations of the Section: H. C. Allehoff, foreman painter, Oregon-Washington Railroad & Navigation Company, Portland, Ore.; F. B. Davenport, foreman painter, Pennsylvania, Columbus, Ohio; J. W. Gibbons, general master painter, Atchison, Topeka & Santa Fe, Topeka, Kan.; H. Hengeveld, master painter, Atlantic Coast Line, Waycross, Ga.; B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J., and D. C. Sherwood, foreman painter, New York Central, West Albany, N. Y. The members of the Section voted to hold the 1927 annual convention at Louisville, Ky.

Abstracts of several of the reports are given below and others will appear in a later issue.

A. E. Green (C. & N. W.)
Chairman

James Gratton (B. R. & P.)
1st vice-chairman

F. E. Long (C. B. & Q.)
2nd vice-chairman

Maintenance and care of paint and varnish at terminals

The committee report embodied the following recommendations for cleaning of exterior of passenger cars:

For the regular cleaning, all newly painted and varnished cars operating in regular service to receive the regular terminal washing with clear water only for the first 60 days of service or as long as the luster remains, and thereafter dry wiping, particularly in the case of wooden cars, as the water from continuously washing seeps in around window molding and other parts which causes the wood to swell and the paint to peel off in patches, permitting rapid decay.

For periodically cleaning, the exterior of cars in first

class trains and main line service are to be cleaned with oxalic acid or any approved cleaner when the condition of the cars demand it. If oxalic acid is used, after it has been applied and all dirt loosened, care should be taken that the surface be thoroughly washed with water so that no acid or dust remains on the body of the car. In renovating, the body of the car should be gone over with an approved renovator after each periodical washing in order to bring back the luster of the finish as much as possible, as well as to remove any traces of acid that might remain.

Interior cleaning of passenger cars

All passenger cars should be blown with compressed air and all dust removed at the end of each trip or when deemed necessary. When necessary to wash the interior finish, a weak solution of soap and water should be used, the finish rinsed thoroughly and dried with a cloth or chamois skin. Floors should be mopped with water to which disinfectant has been added, and care taken that no water remains on the floor, causing it to become water soaked, which is injurious to the floor and underframe. Toilets, baggage and express car floors should be washed with a disinfectant solution. Vestibules are to be washed with soap and water and dried with a cloth or chamois skin.

Painting of passenger cars

Where practical, a painter should be employed to do all necessary touching up at passenger terminals and coach yards, and care should be taken to keep painted all exposed surfaces that should be painted. This not only adds to the appearance of the car but should be done as a matter of preservation, thereby extending the period between shoppings.

Engine cleaning

Where a washing machine is available, the locomotive is to be placed on a wash track and washed with the machine. This washing should be done at the conclusion of the trip before the locomotive enters the enginehouse to enable the inspectors and mechanics to do their work better. Where a machine is not available, the locomotive is to be wiped with a suitable oil, with the exception of the tender and cab which should be cleaned in a suitable manner and renovated if necessary.

The front end and firebox are to receive a suitable front end paint, and where the paint shows a tendency to scale, it should be removed and cleaned to the bare iron and repainted before the locomotive is placed in service.

The report was signed by K. J. Johnson (chairman), foreman painter, N. C. & St. L.; J. H. Whittington, master painter, Chicago & Alton; J. J. McNamara, foreman painter B. & O.; J. McCarthy, foreman painter, Canadian National; H. E. Brill, foreman painter, A. T. & S. F., and B. D. Mason, master painter, Colorado & Southern.

Report on shop construction and equipment

The up-to-date and modern paint shop should be built convenient to the car repair and cabinet shops, as these three shops go to make up a unit of one car output. We will all agree that the construction of a paint shop should be as near fire-proof as possible. The size of the shop and the number of cars on a track is determined to a great extent by the maximum output of the shop that is required.

A building or general stock room adjacent to the paint shop for supplies that come in carload lots is very essential to a modern paint shop where paint and other supplies can be drawn in smaller quantities, as required each day, thus eliminating any large quantity of combustible material in paint shop. This latter building should be of steel, brick and cement construction with raised platforms on each side the height of car doors for unloading of barrels and other heavy paint shop materials.

The paint shop stock room, as a general rule, is best situated between the main shop and varnish room, which should be at one end of building. This end of the building should be of two-story construction with dressing room, lacquer room, and stock room on the first floor, varnishing room and upholstering room on second floor, with elevator at one end for moving seat cushions and window sash, etc., for paint and repairs. Lavatories should be between the first and second floors at other end, with stairs leading to them, and continued to the varnish room above.

The main shop should be equipped with permanent staging, weight balanced so as to be operated with the foot.

The three essentials of a paint shop

In a paint shop there are three essential things to consider:

Light—Any painter will tell you it is very unsatisfactory to try and work by artificial light, therefore there should be all the light possible from the top and sides of the shop. Skylights should be situated so as to throw all light possible on the sides of cars; also the top half of shop doors should be glass so as to throw light on the ends of cars.

Heat—A railroad can build the most modern and up-to-date shops possible but if not supplied with a sufficient amount of heat during the damp cold months of fall and winter the shop is destroying the durability of the paint and varnish, rather than poor material sometimes laid to the manufacturer that supplies it.

Ventilation—This is just as essential to get the best results out of material and labor as heat, in fact the two go together; therefore a good supply of ventilators should be situated on top of the shop and regulated so as to change the stagnant air in the shop for fresh air, which is a dryer in itself.

The majority of railroads today are changing from the wooden car to the steel constructed car and a good many of the smaller roads are not equipped to take care of this class of equipment in the matter of removing the old paint from the exterior and interior of the steel passenger coaches, so that the sand blasting plant, another unit of the paint shop, has become necessary. Other methods of removing paint from steel equipment have been tried but nothing yet has been found that will equal the sand blast. This plant should be about 300 feet from the paint shop in order to eliminate dust getting in where varnish and paint are being used. No railroad should be without a plant of this kind as it is as essential for freight equipment and passenger cars.

All paint shops should be equipped with one or more paint spraying machines (a necessary evil). The spraying machine has its place on practically all railroads of the country today and the work it performs would be had to duplicate by hand. A great many railroads have gone into the spraying of equipment quite extensively using the spraying for all freight and a good part of their passenger equipment. The major part of the above-mentioned work can readily be done out of doors where the vapor is carried off but should not be done in a

closed shop without some provisions for carrying off the fumes and vapor.

The report was signed by J. T. MacLean (chairman), foreman painter, B. & M.; A. H. F. Phillips, foreman painter, N. Y. O. & W.; O. S. Minnick, master painter, W. M.; C. E. Ream, foreman painter, Penna., and W. F. James, foreman painter, A. C. L.

Painting developments with economies involved

The introduction of the lacquer system of painting is bringing about a reduction in the time equipment is held in the shop. The manufacturers of lacquer frequently figure a great saving of labor required to apply their material, because it is applied by spray. This claim should not be allowed or figured in as an economy over the enamel or varnish finish, for it is a proved fact that these materials can also be successfully applied with a spray gun. The tests on lacquer have progressed sufficiently to justify the statement that they are of great value to the painting trade.

The pro and con of lacquer

How wide the field in which they can be used depends largely on the following: It is durable? Will it give the desired appearance? Can it be cleaned in a satisfactory manner?

The experience we have had with lacquer finishing coats has been entirely satisfactory. The complete lacquer systems having the lacquer primers and surfaces, as well as finishing coats, have been successful when applied on metal, and under this method of painting the equipment can be turned out of the paint shop in four or five days. However, tests made of these lacquer primers and surfaces on wood have not been entirely satisfactory, but improvements are being made to overcome this objection. Appearance is a question of taste. Some people profess to prefer the egg shell gloss given by lacquer to the high gloss obtained by varnish. However, the manufacturers are now making lacquer finishing coats that have a high gloss, so the purchaser can secure the kind of finish desired. A lacquer finish can be more easily cleaned than an enamel or varnish finish, and from that standpoint is more economical than all other systems.

The objections to lacquer that must be considered and satisfactorily met before it is universally adopted are first, its strong odor, which is very offensive to some workmen; second, its inflammability, which, compared with other materials used in paint shops, has been, in our opinion, greatly exaggerated; third, while there are brush lacquers on the market, the lacquers that have proved their worth must be applied by a spray gun, and in some states there are unreasonable restrictions placed upon the spraying of paint materials. Your committee would, however, emphasize the necessity of installing adequate ventiliating systems wherever paint, varnish or lacquers are applied with spray. On locomotive parts, such as engine frames, wheels, trucks, rods, etc., owing to the impossibility of removing all traces of grease, lacquers are not a success as made today.

The speed at which equipment can be run through the shop by the introduction of the above methods has saved thousands of dollars that would have been required for additional shop room if the old system of painting had been maintained.

The introduction of the patent surfacer systems also effected a saving of labor because they were much easier to rub down to surface. The substitution of composition rubbing stone in place of the cake pumice stone has also been a factor in saving labor. The wet and dry grade of sand papers are now being used and by their use a further saving in labor has been effected but the same smooth surface is not maintained. Some railroads have eliminated the surface coats and only paint for durability, regardless of appearance. The committee believes that this is not true economy, as equipment finished in this way requires more labor to keep it clean and in a sanitary condition.

While the committee does not advocate a return to the elaborate scroll work formerly used, we would call the railroad managers' attention to the fact that the merchant who decorates his display window and store in a neat and attractive manner secures the major portion of the business in his line, and that there is a well defined line between what is economy, and what will repel the trade, and this line should never be crossed by a well managed railroad.

The mechanical painting situation

The greatest economy of labor ever effected in applying paints, enamels, varnishes or lacquers has been done with the spray. When sprays were first introduced, about thirty years ago, they were more properly speaking squirt guns, and applied the paint in uneven splotches and it ran and sagged in such a manner as to present a very uneven appearance, and it frequently alligatored and checked. During the World War, and immediately afterward, the spray gun was so much improved that an even coat can be applied that presents as smooth appearance as the same materials applied with a brush. In fact, it requires less experience to get a smooth job with a gun if the materials are properly mixer than to apply them with a brush.

There has been a question as to the durability of paint, varnish and enamels applied with a spray gun. Many of the devices on the market will not apply sufficient material to protect the surface. But this is not true of all spray guns.

For the successful and economical use of the paint spraying machine, the following is absolutely essential.

1—Perfect atomization of materials to be sprayed.
2—Control of air pressure and flow of paint.
3—A sufficient quantity of compressed air at all times to insure a steady flow.
4—The elimination of moisture from compressed air.

The use of paint spraying machines resulted, for certain classes of work, in a great reduction of labor cost. Under some circumstances, particularly where used in the open air when a breeze more or less heavy is blowing, it is admitted that much material is lost by use of certain types of machine painting, so much so that the saving effected in labor is more than offset by loss of material. This is particularly true of freight car painting, where the material use constitutes approximately two-thirds of the cost and labor one-third. If carefully watched, however, these matters can be controlled if a suitable and economical spraying device is used.

Shield or masking coat materials are available on the market that are a great aid to economical spray painting. This material can be applied over letters, glass, or other parts of equipment on which we do not want the spray coat to adhere, and when the car or locomotive part has been finished this shield coat can be removed with comparative little labor, thus adding greatly to economies of spray painting.

Baking paints, enamels and varnishes

A number of railroad and car manufacturing companies have installed devices to accelerate the drying of

paint, enamels and varnishes, and have thus made it possible to cut down the time equipment is held in the shop for painting to the minimum. Extensive tests run over a period of 10 years has proved that paint, enamels or varnishes, when drying, if properly accelerated, wear longer, are easier cleaned, and maintain a good appearance longer than the same materials air dried.

The sand blast is another device that has assisted in bringing about economy in painting locomotives, steel cars and structural iron and steel of all kinds. The sand blast has not only made it possible to remove old paint, flash scale, and rust from the surface, but it leaves a perfect surface, to which paint will readily adhere. The installation of patent paint burners in place of the hand torch have also added to the efficiency of the paint department.

Summing up the economies effected, as outlined above, the committee is convinced that there is absolutely no legitimate excuse for any railroad management to permit their property to deteriorate for lack of paint protection, nor is there any reason why the traveling public should be asked to ride in equipment that is unpleasing to the senses. On the other hand, the success of the several railroads that have installed specially painted and decorated trains in their passenger service is proof that the public appreciates and will patronize passenger trains that are maintained in a high class manner.

The report was signed by J. W. Gibbons (chairman), general master painter, A. T. & S. F.; B. E. Miller, master painter, D., L. & W.; F. E. Long, foreman painter, C. B. & Q.; C. W. Carter, master painter, St. L.-S. F., and B. F. Fultz, foreman painter, N. Y. C.

Report on standards—Cars and locomotives

The subject of standardizing the interior and exterior painting of passenger carrying steel equipment has become quite difficult at this time owing to the tendency of our main roads to have their passenger equipment finished entirely different from present practices.

For that reason, your committee is presenting to you, different methods of painting this equipment which may be adopted as a standard by railroads and which your committee considers good practice.

Exterior of steel equipment new or repainted when sand blasted.

First Day—Sand blast and prime with Railroad Company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Coat of surfacer.
Sixth day—Coat of surfacer.
Seventh day—Coat of surfacer.
Eighth day—Sandpaper with "Wet or Dry" sand paper and water or rub with rubbing brick and water to a smooth finish.
Ninth day—Sandpaper lightly to remove grit which may not be thoroughly washed off after rubbing and touch up with primer any spots rubbed through.
Tenth day—Coat of body color ground in japan, thinned to brushing consistency with pure turpentine, also coat of semi-gloss body color.
Eleventh day—Letter and stripe.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day—Varnish.
Fifteenth day—Stand to Dry.
Sixteenth day—Varnish.

Roof and deck.—Prime with a basic chromate of lead primer followed by at least two coats of Railroad Company's standard roof paint.

Underframe, battery box fronts and steps.—When new coat with basic chromate of lead primer then apply two coats of oil color, if not new, two coats of oil color should be applied.

Trucks.—2 coats oil color.

Note:—Where a better finish is required on steps and battery boxes they should be brought along with primer and surfacer and painted and varnished with body of car.

Interior of steel equipment, new, or repainted when sand blasted.

First day—San blast and prime with railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Coat of surfacer.
Sixth day—Sandpaper dry or with "Wet or Dry" sand paper and water. If sandpapered with water a day should be allowed for drying.
Seventh day—Coat of ground color.
Eighth day—Sandpaper lightly and second coat of ground color.
Ninth day—Grain.
Tenth day—Varnish.
Eleventh day—Letter and ornament.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day.—Varnish.
Fifteenth day—Stand to dry.
Sixteenth day—Stand to dry.
Seventeenth day—Rub with pumice stone and water.
Eighteenth day—Polish with rotten stone and oil.

Where not as smooth a finish is desired the following schedule is recommended:

Exterior body

First day—Sand blast and prime with Railroad Company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat with surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper dry and apply body color ground in japan and thinned to a brushing consistency with pure turpentine.
Sixth day—Coat of semi-gloss body color.
Seventh day—Letter and stripe.
Eighth day—Varnish.
Ninth day—Stand to dry.
Tenth day—Varnish.

Interior body.

First day—Sand blast and prime with standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Sand paper dry and apply first coat of ground color.
Sixth day—Sand paper lightly and coat of ground color.
Seventh day—Grain.
Eighth day—Varnish.
Ninth day—Letter and ornament.
Tenth day—Varnish.
Eleventh day—Stand to dry.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day—Rub with pumice stone and oil.

If enamel is to be used on interior instead of graining system same may be applied on the 5th day, 2nd coat on the 7th day and apply lettering and ornamenting on the 8th day.

A still shorter schedule we believe is proving satisfactory on the exterior of steel equipment and the schedule is as follows:

Exterior of steel equipment.

First day—Sand blast and prime with railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer, surfacer to be the same or near the same shade as body color which is to be applied.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper dry and apply one coat of semi-gloss.
Sixth day—Letter and stripe and apply first coat of varnish.
Seventh day—Stand to dry.
Eighth day—Second coat of varnish.

Owing to the fact that wooden equipment is fast going out of date your committee has not made any recommendations as to the finishes on such equipment.

Freight equipment—steel

When painting new or badly chipped and rusted open-top cars, remove rust by sand blasting, then prime with basic chromate of lead followed with two coats of carbon black or railroad company's standard color.

For all-steel box cars, after sand blasting, prime with basic chromate of lead followed with two coats of railroad company's standard body color, preferably oxide of iron.

All steel underframes should be sand blasted or thoroughly scraped clean of rust or scale, then coated with a coat of metal protector primer followed with one coat of railroad company's standard color.

Roof.—If steel, the roof should be sand blasted and primed with same material as body of car, then followed with two coats of railroad company's standard roof paint. If roofs are of galvanized iron and new, two coats of Railroad Company's standard roof paint should be applied. If galvanized iron roofs are old, rust and scale should be removed by light sand blasting and they should be primed with basic chromate of lead followed by two coats railroad company's standard roof paint.

The committee recommended that all paint on freight equipment be sprayed on.

Locomotives

A practical and economical method of painting all types and classes of locomotives by brush or spraying machine is as follows:

On a locomotive that is badly checked and cracked and the finish has deteriorated to the extent that it has become short and brittle and on newly built locomotives, your committee recommends that all old paint, rust, scale and grease be thoroughly removed from the metal, preferably by sand blasting. When thoroughly cleaned prime with a coat of metal protector primer, black in color. Putty and glaze where necessary and apply one coat of surfacer, also dark in shade.

As all steel is more or less pitted, your committee leaves you to be the judge of the number of coats of surfacer needed to build up as smooth a surface as may be desired and in severe cases would recommend that a knifing coat be used.

Sand paper and apply one coat of locomotive black finish. Letter and stripe in accordance with railroad company's standard. Varnish with a coat of engine finishing varnish (two coats on passenger and one coat on freight locomotives). The locomotive black finish and finishing varnish should be resistant to both hot and cold water.

On locomotives that have a good body, free from checks, etc., but where the finish has become dull in appearance, the engine being in shops for general repairs, your committee recommends the following:

All grease and grit should be thoroughly removed by washing with suitable solvent that will cut the grease and will not injure to the finish. Sand paper and touch up with primer, putty where necessary all abrasions, sand paper and apply one coat of locomotive black finish, letter, stripe and varnish in accordance to class of engine.

While the above schedules for passenger and locomotive painting are based on brush work, it may be well to mention at this time that spraying machines are entering into the applying of primers, surfacers and varnish quite extensively; also the lacquer system has been used by some roads quite extensively but at this time we believe is still in the experimental stage; but if they prove satisfactory will no doubt, in due time, change the standard of painting on this equipment.

There are upon the market today a number of paint spraying machines and while all are built upon practically the same principle there is quite a difference in their construction and operation. These spraying machines in the painting of railway passenger, locomotive and freight equipment without doubt will be a great labor saver, as a paint spray in the hands of a competent operator can accomplish the same amount of work that would ordinarily require three or four men with a brush. The same amount of material can be applied with a spray as a brush and just as satisfactory and in some cases more so, especially upon the steel equipment as it makes a cleaner job around the rivets and aprons.

In considering the installation of a spraying machine the following items should be given very careful consideration: Exhaust fan should be installed in the proper locations in order to lift and carry off all fumes and mist which results from spraying. Light and ventilation should be the best obtainable. Respirators and goggles should be used by operators. Where possible the spraying should be confined to one, two, three or more tracks with a partition making one room for this work. The sprays and all equipment should be taken care of and kept in good clean condition.

One more item in favor of the spraying machine, the operator can turn on the air and blow out all dirt and dust from nail holes, corners and places which are very difficult and impossible to reach with a dust brush, then turn on the material, shooting the paint into all screw and nail holes, corners and other places not reached with a brush.

The report was signed by D. C. Sherwood (chairman), foreman painter, N. Y. C.; G. H. Lehnen, foreman painter, C. & E. I.; A. E. Green, foreman painter, C. & N. W.; F. E. Long, foreman painter, C. B. & Q.; J. N. Voerge, general master painter, C. P.; K. J. Johnson, foreman painter, N. C. & St. L., and A. F. Lawson, foreman painter, P. & L. E.

Extension and feed screw for air drill

By V. T. Kropid

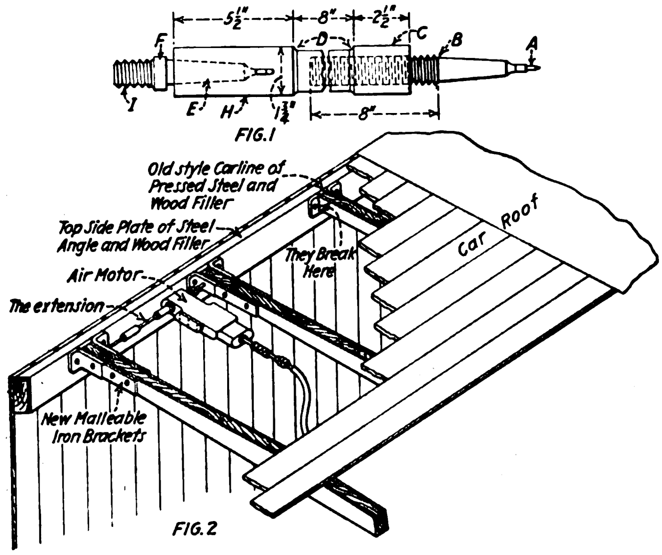
Quite frequently the pressed steel carlines of steel frame box cars break in the bend of the foot riveted to the top side plate, as shown in Fig. 2 of the sketch, because of the rigidness of the construction. To overcome this fault, the car repair shops on this road are cutting off the feet of the carlines with an acetylene torch when the cars come in for heavy repairs and a malleable iron bracket is applied, which provides a more flexible and a reinforced joint. This necessitates the drilling of the carlines for the reception of the bolts that fasten the bracket to the carline. A close-quarter air drill must be used on account of the holes being located close to the side plate.

In trying to use the drill it was found that the feed screw was too short and that there was no efficient way of bracing the motor. This problem was put up to the toolroom machinist, and he devised a combination extension and feed screw which has proved to be successful.

Fig. 1 of the sketch is a drawing of the extension, and Fig. 2 shows the application of the extension with the close-quarters drill in operation. The extension consists of the parts *H*, which is of mild steel and is bored to

receive a No. 3 Morse taper shank, and *C*, which is made of brass and is tapped out for a 1-in. standard thread screw. *H* and *C* are joined by being acetylene welded to a piece of extra heavy 1¼-in. pipe. A 1-in. screw *B* has welded to it a No. 3 Morse taper shank, into the end of which is screwed a ¼-in. tool steel center *A*. The short screw *I* has a hexagon *F* and a No. 3 Morse taper shank *E* welded to it. The hexagon *F* is for the purpose of feeding the drill.

The extension can be used at either end of the air



The combination extension and feed screw for an air motor drill and how it is used on a car

drill by interchanging the screws *I* and *B*. When applied to the rear of the motor it is used as shown by screwing *I* into the original feed screw end of the motor. When used in front of the motor, the shank *B* is inserted in place of the drill. The screw *I* is removed and a drill is inserted in its place, the original motor center being used in this case.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Authority for renewal where material could not be properly repaired

A. R. L. refrigerator car No. 14266 was received at the Chicago shops of the Armour Car Lines on October 18, 1922, carrying Charleston & Western Carolina defect card, issued at Augusta on September 26, 1922, covering the following defects: Two corner boards damaged; twelve side sheathing damaged; five roof boards damaged; one metal tie beam bent. Joint evidence was secured and under date of November 8, 1922, the Charleston & Western Carolina furnished the Armour Car Lines with a defect card reading as follows: Two Andrews truck sides bent, 1-AL and 1-AR; one bottom section door lever bent BL; one channel spring plank bent, B; one section cross over pipe applied and one 1¼-in. dust collector omitted. October 19, 1922, the Armour Car Lines made repairs to the car and rendered a bill for $102.05 against the Charleston & Western Carolina on authority of above-mentioned defect cards. Among other items of repairs charged in the bill were two new cast steel Andrews truck sides, 405 lb. each, net $52.46, labor 5.8 hrs. The C. & W. C. took exception to the charge for the new truck sides, claiming that their defect card reading "two Andrews truck sides bent," should be reduced to cover the cost of straightening only. To this exception the Armour Car Lines replied that the truck sides had not been straightened, but had been removed and scrapped and that new truck sides had been applied; therefore, the charge for the new truck sides was proper and in accordance with the repairs made.

In rendering its decision, the Arbitration Committee stated that, "there is no evidence to substantiate that the contention that the two damaged truck sides could have been properly repaired. The bill of the Armour Car Lines is sustained.—*Case No.* 1365, *Charleston & Western Carolina vs. Armour Car Lines.*

Failure to stencil the car with the rebuilt date

On March 10, 1923, the Southern Pacific made repairs to M.-K.-T. car No. 82205, for which it billed the owner for $1,698.17. The owner objected to a charge of $30.40 for the difference between the value of a Westinghouse K-1 triple valve applied and the New York F-1 non-convertible valve removed, advising the Southern Pacific that the car in question was built during August, 1909, and requested that the triple valve charge be confined to $11.30 in accordance with Item 57-D, Rule 101, of Supplement No. 1 to the 1922 Code of Rules. The Southern Pacific refused to make a reduction to this charge, claiming that inasmuch as its billing repair card as well as its original record of repairs, indicated that the car was stencilled "Rebuilt February, 1919," the charge of $30.40 was correct and in accordance with Interchange Rule No. 101. The repairing line also stated that owing to the fact that the car was stencilled "Rebuilt February, 1919," the charge was made against the owner as prescribed in the answer to Interpretation No. 6 of Rule 17, 1922 Code.

The Arbitration Committee rendered the following decision: "The preponderance of evidence indicates that the car bore stencilling showing the original date built and, therefore, under the rules, the bill of the Southern Pacific should be corrected in accordance with Item 57-D of Rule 101."—*Case No. 1369, Southern Pacific vs. Missouri-Kansas-Texas.*

Light weight stencilled on destroyed cars to govern settlement

On January 6, 1924, six Delaware & Hudson cars were destroyed on the Boston & Maine. The car owner and the handling line could not agree on the settlement for four of the cars owing to a difference of opinion as to the light weights stencilled on the cars according to A. R. A. Rule 112, paragraph B. On January 14, the Boston & Maine received a statement from the Delaware & Hudson, giving the net value of all cars in question, the settlement to be based on the light weights of the cars. On receiving this statement, it was found that for four of the cars the stencilled light weights did not agree with the weights as given by the D. & H. The B. & M. in an effort to make settlement and close the case, agreed to accept the weights as given by the

D. & H. for two of the cars. This was done with the thought that the car owner would concede the weights on the remaining two cars. But inasmuch as the D. & H. insisted on settlement according to its records of the light weights of the four cars, the B. & M. withdrew its concession on two of the cars, basing its claim on the light weights as stencilled on the cars at the time of destruction, in accordance with A. R. A. Rule 112, Section B. The D. & H. stated that the A. R. A. rules prescribe a definite course of procedure, from which any departure in this instance was unwarranted, and furthermore, that the B. & M. did not furnish proof that the records of the owner were incorrect.

The Arbitration Committee rendered the following decision: "Rule 112, section D, provides that settlement for destroyed cars shall be on the basis of stencilled light weight on the car at the date of destruction. A reasonable interpretation of the rule would be that the weight shown on the car should govern, and that in the event the light weight of the car is not stencilled thereon, the weight as shown by the owner's records should govern. In the case at issue, the B. & M. has a clear record as to the light weights stencilled on the cars and the weights so reported should govern.—*Case No. 1370 Boston & Maine vs. Delaware & Hudson.*

Again—Rule 32

On December 5, 1922, the Southern reported for disposition under Rule 120, Atlanta, Birmingham & Atlantic car No. 10,046, at which time the usual inspection certificate was furnished. The handling line reported that, while in ordinary switching service, the car broke in two owing to its decayed and weakened condition. An investigation failed to develop that the car had been derailed, cornered, sideswiped, or that it had received any other handling which, under the rules, could be termed unfair usage. The owner contended that the fact that the car had been completely demolished was indicative that it had been derailed and thus destroyed.

In rendering its decision, the Arbitration Committee stated that "the car was not subjected to any of the unfair conditions of Rule 32. The owner is responsible.—*Case No. 1368, Southern vs. Atlanta, Birmingham & Atlantic.*

Use of billing repair card as joint evidence

On February 7, 1921, the Bessemer & Lake Erie reweighed N. O. T. & M. car No. 8767, for which work it charged, showing on its repair card the following information: Old weight, 35,800 lb., K. V., 1-18; new weight, 36,800 lb., G. S., 2-21. On January 5, 1922, the Santa Fe reweighed this car, for which work it charged, showing the following information on the repair card: Old weight, 37,400 lb., DeQ., 10-17; new weight, 34,600 lb., G. H., 1-22. Upon receipt of the Santa Fe repair card showing the subsequent reweighing, the Gulf Coast Line forwarded the Santa Fe repair card, together with the repair card of the Bessemer & Lake Erie, to the general auditor of that company, complaining that the Santa Fe card was evidence of the fact that the car was not properly stencilled after being weighed by the Bessemer & Lake Erie, and requested that the charge be cancelled in accordance with Rule 90. The Bessemer & Lake Erie refused to cancel this charge, claiming that the car had been weighed and properly stencilled as indicated by its repair card.

The Arbitration Committee rendered the following decision: "The statement of facts in this case is absolutely at variance. However, the question has been submitted to the Arbitration Committee, who, in view of the above situation, are restricted to a technical decision under the rules. Therefore, in accordance with Rule 90, the bill of the Bessemer & Lake Erie should be cancelled."—*Case No. 1367, Bessemer & Lake Erie vs. Gulf Coast Lines.*

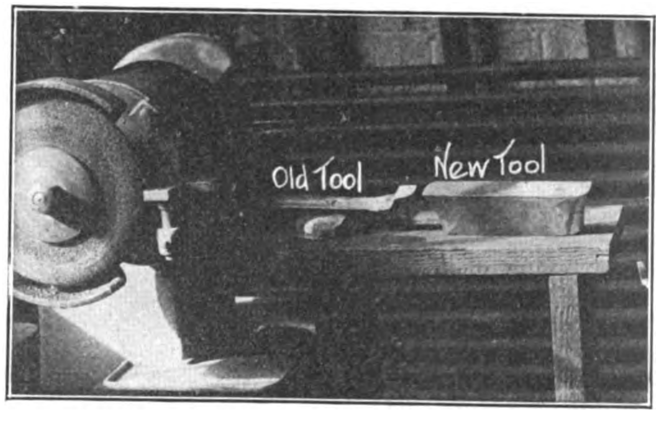
Removal of new wheels on same road within 30 days

On March 10, 1924, the Southern Pacific applied a new pair of wheels to W.H.O.X. car No. 1430 on account of a wheel with a worn vertical flange, the other wheel being O.K. On March 14, 1924, the Southern Pacific removed the same pair of wheels on account of a rough journal, applying new wheels and charging the owner for the difference between the new wheels applied and the second-hand wheels removed. It is the contention of the United Central Oil Corporation that the charge for the second application of the wheels should be cancelled as the wheels removed had been applied only four days previously, and, therefore, the charge is not in accordance with the intent of the A.R.A. Rules of Interchange. The Southern Pacific declined to cancel its charge, claiming that it is fully covered by A. R. A. Rule 98, section and interpretation 6 of this rule.

In rendering its decision the Arbitration Committee stated that "the circumstances in this case are such as to constitute an equitable exception to Section (b) of Rule 98. In any case where the charge has been made against the owner for the difference in value between new and second-hand wheels, if they are subsequently removed on the same road within 30 days from the date of application, the charge for such difference in value between the new and second-hand wheels should be withdrawn. The same ruling will apply to axles.—*Case No. 1371, Southern Pacific vs. United Central Oil Corporation.*

Reclaiming car wheel turning lathe tools

SHOWN in the illustration are two lathe tools, the "old tool" being a standard design for turning car wheels on a wheel lathe and the "new tool" an example of how the "old tool" can be reshaped for turning car



The new tool, made from the old tool, is ground to a cutting contour at both ends

wheel journals. The "new tool" which is made from the old car wheel lathe tool after it has been worn down to its limit of length, is about 12 in. long, 1½ in. wide by

3 in. deep. It is ground to a proper cutting contour at both ends. As the tools of the old design become worn to a point where they are no longer good for service, they are sent to the blacksmith shop where they are forged into the new shape, as shown in the accompanying illustration.

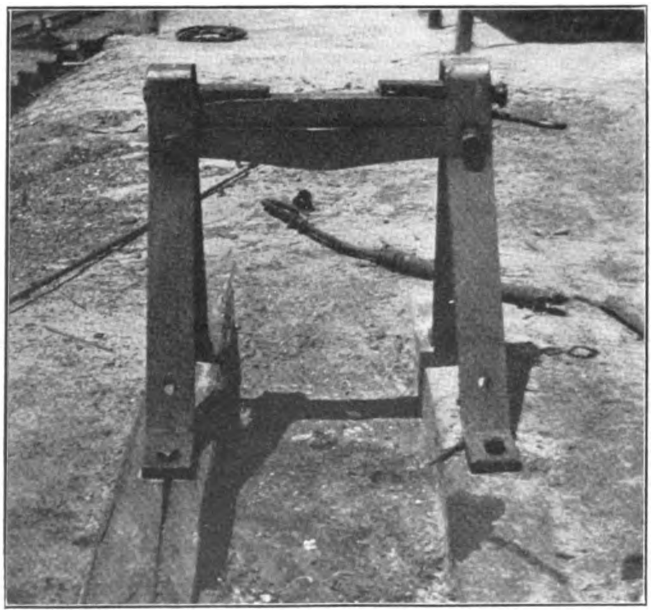
This idea has been found to be quite practical by B. B. Isom, gang foreman, car department, Norfolk & Western, Portsmouth, Ohio, and by F. H. Wickes, toolroom foreman, and that by reshaping car wheel lathe tools for turning car wheel journals, there is a considerable saving in the use of high-speed tool steel. In fact, the conservation of high-speed tool steel has not been confined to car wheel lathe tools, but to cutting tools of the same material used on other machines as well. All the work to be done on the new tool on the part of the blacksmith shop is to give it the proper heat treatment.

The tool posts on the car wheel journal lathe must be altered to accommodate the shorter tools. The proper elevation of the tool is obtained by using a step ring on the tool posts. The heavier ring is desirable on account of its rigidity which if need be, will take a heavier cut and still produce a smooth surface for rolling. The new tools now in use at Portsmouth have turned 16 axles without regrinding.

After the tools received from the car wheel lathe have been used on the journal turning lathe to a point where they are too short for that work, they are sent to the smith shop and forged into a smaller section for other tools, and after this to still smaller tools, and so on to smaller sections and lengths as long as serviceable.

Clamp assists in making draw head yokes

THE device shown in the accompanying illustration was designed by a car repairman to assist in properly bending the shoulders on the ends of draft gear yokes.

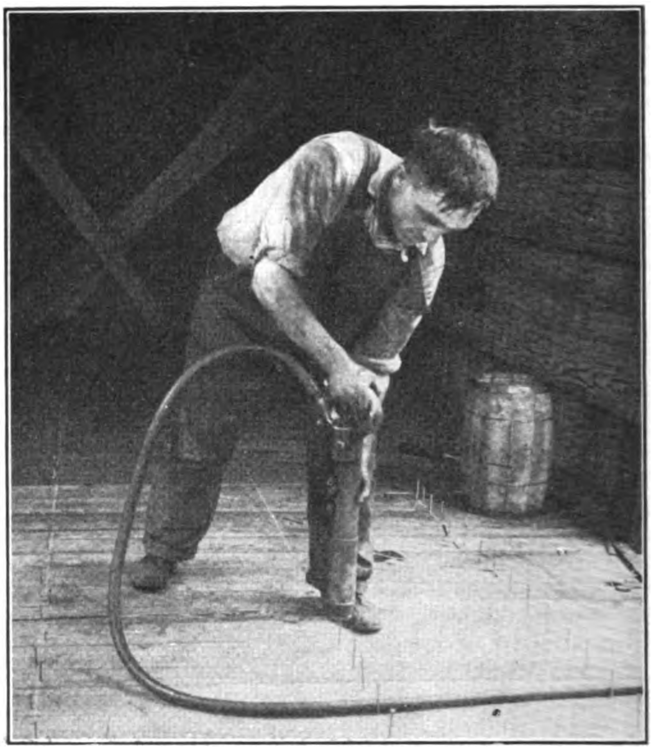


Couple yokes may be quickly bent in this clamp

This device is made up of two pieces of the yoke material shaped in general like an inverted vee with feet bent on the lower ends, which are bolted on the top of two heavy timbers imbedded in the earth. In the upper bend of these pieces is bolted a piece of heavy iron 2 in. thick and 3 in. wide. Another similar bar lies in the loop of the stand pieces or legs. Two iron wedges are used to drive between the top of the loops and the loose bar. The wedges are removed and the yoke material, which has been heated, is slipped between the two bars and the wedges driven in tightly clamping the piece in place. When the wedges are driven in tightly the pieces are clamped fast and heavy blows will not move them in the clamp. The ends are hammered down against the side of the lower clamp bar and finished, making a perfect right angle.

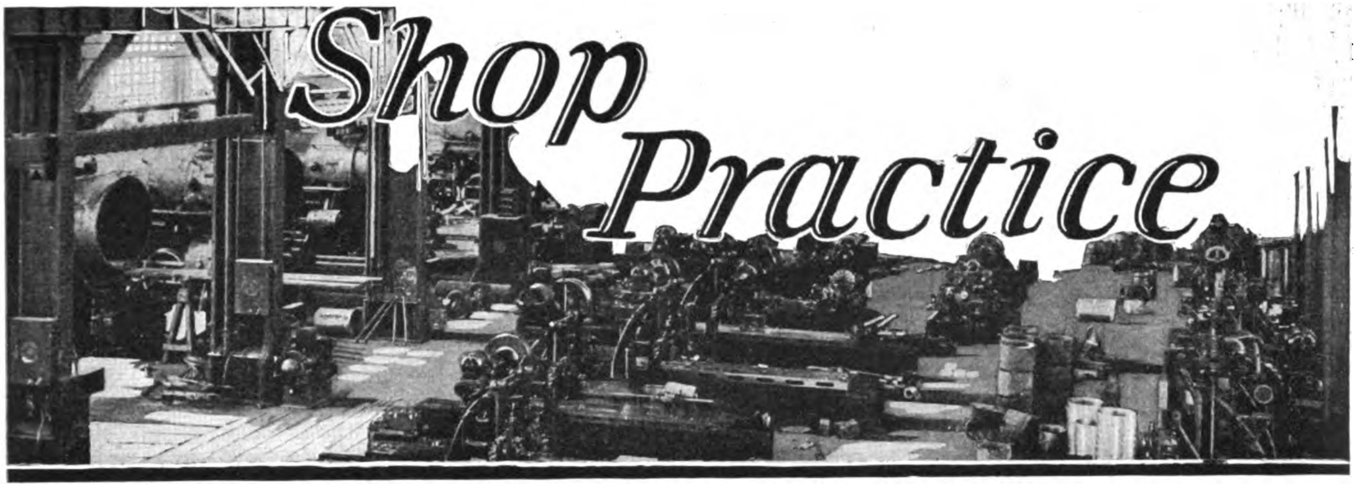
Driving nails with an air hammer

ONE of the interesting developments in car repair work is the wide variety of uses to which pneumatic tools can be put. The manufacturers of pneumatic tools furnish rivet sets cupped to various shapes as well as blanks of various diameters for air hammers. A cupped rivet set can frequently be adapted to work other than for which it is intended or can be easily altered



Nail driver in use at the car shops of the Lehigh Valley, Sayre, Pa.

for special jobs, such as driving nails. A number of car repair shops use an air hammer for driving nails in much the same manner as shown in the illustration. The set used in the hammer shown is made from a blank, although it can be made from a small rivet set. The set is cupped to suit the head of the nail and the face of the set is rounded off to the outside so as to enable the operator to sink the head of the nail in the wood. This method of driving nails is employed at the Lehigh Valley car shops at Sayre, Pa.



Tool foremen hold live meeting

Fourteenth annual convention featured by report and discussion on standardization

THE most important subject considered at the fourteenth annual convention of the American Railway Tool Foremen's Association held at the Hotel Sherman, Chicago, September 1 to 3, inclusive, was undoubtedly that of standardization, attention being centered this year on the standardization of present special boiler taps. The convention was opened with an address by L. A. Richardson, general superintendent of motive power of the Chicago, Rock Island & Pacific, followed by the address of President E. A. Hildebrandt, machine shop foreman and formerly tool foreman of the Big Four at the Beech Grove shops, Indiana. Various reports on new tools, safety devices and shop kinks for both locomotive and car shops were presented, as well as a report on labor saving tools for the air brake department. The standing committee on standardization directed its attention this year to the standardization of present special boiler taps. In connection with this report, the address by E. W. Ely, assistant director of the Department of Commerce, entitled "Simplification, a New Tool for the Tool Foreman" was highly pertinent and much appreciated by the members.

Election of officers

At the closing session of the convention, new officers for 1926-27 were elected as follows: President, O. D. Kinsey, supervisor of tools, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; first vice-president, E. A. Greame, tool foreman, Delaware, Lackawanna & Western, Scranton, Pa.; second vice-president, W. R. Millican, tool foreman, Missouri-Kansas-Texas, Parsons, Kans.; and third vice-president, H. P. Jones, tool foreman, Oregon Short Line, Pocatello, Idaho. G. G. Macina, Chicago, Milwaukee & St. Paul, Chicago, was re-elected secretary-treasurer. Three new members were elected to the executive committee which now consists of Chairman J. T. Jones, tool foreman, New York Central, Collinwood, Ohio; C. A. Schaffer, general supervisor of shop machinery and tools, Illinois Central, Chicago; J. T. Sumner, tool foreman, Michigan Central, St. Thomas, Ont.; W. J. Hynes, tool foreman, Missouri Pacific, Little Rock, Ark.; and G. F. Harney, tool foreman, New York, New Haven & Hartford, Readville, Mass.

Mr. Richardson's address

The ever-increasing weight of locomotives and the increased number of special appliances used therewith, have made necessary a considerable increase in the size and capacity of machine tools. Increased production and increased accuracy are also essential.

The general trend in railroad shops toward grinding and milling operations is going to require a more intensive analysis by our tool room men than ever before, for it is to them that we turn when the problem becomes one of extreme accuracy and close tolerances. However, the idea is sometimes erroneously entertained that the function of the tool room in a railroad shop is for the manufacture of tools; such is not the case, nor should it be. The general standard tools are manufactured by reputable concerns whose products give excellent performance. We cannot, and should not, try to compete with them when it comes to the manufacture of standard tools, such as taps, drills, reamers, cutters, etc.

There are a sufficient number of special tools required at a railroad shop to take the full time of any tool room staff in their manufacture and service, and it is to this end that tool foremen should confine their efforts in their daily work. In other words, if maximum production is to be obtained, very close analysis must be made to determine the special jigs and fixtures most economical to use. This is the peculiar function of the tool room staff, for it is only by this effort that such equipment can be developed, and it has only been through such effort in the past that such equipment has been developed.

Another important function of the tool room staff is that of repairing. This includes not only the heavy machinery in the shop but small tools such as pneumatic tools and other small equipment. It also includes the keeping of tools in first-class condition, seeing that they are properly ground, hardened and tempered.

Another function of the tool room staff, many times overlooked, is that of inspection and follow up of tools.

By this I mean that as all new tools put into service pass through the tool room, they should be carefully inspected for accuracy and compliance with standard. This means the use of gages with which every tool room should be supplied; but more important than this is the follow up of tools to determine the cause of breakage or excessive wear, and to run down the cases of mishandling and abuse, and see that such cases are corrected. It is in this capacity that the tool room foreman can save his company many thousands of dollars a year, for unfortunately there is perhaps a greater amount of money wasted in the mishandling and abuse of small tools than in any other single shop investment. The best method for the check can only be developed by individual analysis at each point.

President Hildebrand's address

This is the fourteenth annual convention of our association and should be the best. We are organized to promote the welfare of the railways by providing better tools and methods of fabricating and repairing economically the various parts of locomotives and cars. In the past fourteen years our association has done much good, but modern equipment has forced greater responsibility upon us and we have greater duties to perform. It becomes necessary that we, as tool foremen and tool supervisors, increase our efforts to meet these demands and co-operative work in the American Railway Tool Foremen's Association is one effective way to do this.

Our opportunities along the lines of tool supervision are unlimited. They challenge the best that there is in us. To meet this challenge and capitalize on its opportunities, we must collectively study our mutual problems.

We have passed the experimental stage in our association and the good work of the past shows that we have not labored in vain. While we can feel proud of the work done, we are still on the surface, and there was never a time in the history of our association when our co-operative work and best thoughts were more needed than now. There are many intricate problems in our special field which are difficult to solve, except by combining the experience of many practical tool men.

The topic, "Labor Saving Devices for the Air Brake Department," I believe, is entirely new, and as the air brake department generally takes care of the small accessories such as injectors, lubricators, whistles, pops and the numerous cab valves it becomes necessary that we have the proper tools to maintain this equipment and the many different ideas you have should make a splendid discussion.

"New Tools and Safety Devices for the Car Department" is a topic which covers a large field. Heretofore we always had this combined with locomotive jigs and devices but since there are many car shops which have their own tool foremen I believe the idea of getting a paper in their interest only, will bring some of the car shop tool foremen to our conventions. We certainly want such members and I am certain the papers pertaining to their work will be more thoroughly discussed.

"General Locomotive Shop Kinks and Devices" is a topic that never grows old. There are so many ways of improving old methods or applying new ones to the repair of the modern locomotive that any member who hears this discussion should be well recompensed for the time he has spent here.

Another one of our topics is the "Standardization of Present Special Boiler Taps" which is only a part of our standardization program, yet one of the most important subjects we are confronted with. Standardization of tools is probably the biggest and most progressive movement our association has undertaken. Problems of the greatest importance confront us in this undertaking and if we carefully and properly solve them we can get wonderful results. Let us become thoroughly acquainted with this subject so we can intelligently discuss it and be able to present something of value to the American Railway Association. We must adopt our standards with some definite end in view if we are to serve a useful purpose. Just consider for a moment what it would mean if the manufacturer could carry only one style thread for boiler work and one style reamer for locomotive work. Could not these tools be manufactured cheaper and be sold cheaper with the results that the railroads would be saving in the end? Then again, were you to manufacture these tools in your own tool rooms, would it not mean that you would have to carry a lot of raw material in stock which is capital tied up and would go as overhead expense.

"Training Men Suitable for Toolroom Work" is a topic we have given little thought to until this year and I believe it is one of the most important subjects we have to deal with. The men that you select or who wish to follow toolroom work must have certain qualifications or they will never make a success of tool work.

There will be numerous personal topics which the members will talk over among themselves. No tool foreman has ever attended a convention who has not had some good idea of his own which he was willing to exchange with someone else, so you can readily see that you can receive from others as well as you can contribute to them. And the more you get acquainted the more you will come in contact with the live problems of the day.

Report on training men for tool room work

A tool maker is said to be the aristocrat of the metal working trades. There must be a reason for it, for to be worthy of such a title he must be a man of keen discernment who can look a situation over from various angles, both inside and outside before arriving at a conclusion. He must have confidence in himself so that if he is sent out in the shop to see why a certain reamer, although having a keen edge, will not cut, he may be told by the operator that the trouble is in the steel, but having been taught to investigate for himself, he takes the tool out, looks at the hole and finds it is doing more rubbing than cutting. Thereupon he takes a hone stone and eases the bearing back of the cutting edges slightly and replaces the tool which then works in a very satisfactory manner.

A foreman who has men and boys entrusted to his care to learn a trade should first recognize the importance and the responsibilities of his task. He should prepare himself to teach the things he has learned from years of experience. Tool room foremen are skilled in tool room work but the "Mastery of a vocation is, taken by itself, no guarantee of power to teach that vocation." Much can be learned on this subject from such books as Spencer's "Education" and Paynes' "Method of Teaching Industrial Subjects." It is well also to study the different apprentice systems of our railroads and other industries.

In the selection of men for tool room work some practical experience and a knowledge of men is of great help. If we were privileged to review a line of men with the intent of selecting help for the tool room we would not want to be attracted particularly with the fine physique nor the muscular development of the individual. We

would most likely look him in the eye to discover if he has that bright alert expression in his face that indicates he is quick to grasp an idea and fully alive to everything going on about him. He should have at least a grammar school education, although a high school graduate is preferable, and have the mental capacity to see little things and understand the reason for tools being master products.

In training a boy whom we will expect some day to shoulder the responsibilities of our shops, the greatest care and precaution should be taken in the beginning to get the boy's interest aroused in his work in order to get him to put forth his best efforts in learning to do each task well.

The man with his mind centered on the clock is not interested in his work and will not produce the quality or quantity of work that the man will whose heart and soul is with his labors. It is well to bear in mind that a boy is learning only while he is busy working; all other time is a loss to himself as well as the company. Therefore, keep plenty of work ahead of him, but not enough to cause him to rush from one job to do another.

When the boy starts to work in the tool room it is the foreman's duty to get him interested in the possibilities of tool work as a life work. If he does this and maintains this interest the teaching of the trade becomes a pleasurable task. Any boy that does not become interested, if properly handled, should try some other class of work.

The boy is then assigned a machine to operate, being first shown how to keep the machine properly oiled and cleaned. He is then given a job to perform, preferably something of which he may be furnished a finished sample so that he may have a better idea of what is wanted. He should be allowed to examine samples of work that do not come up to standard if possible and be shown wherein they are below standard. He is then shown how to perform the job by a demonstration by the foreman or a skilled mechanic, being told why each operation is performed in the manner that it is. After this demonstration he should be allowed to take the machine and do the work himself, always being mindful that quality comes before quantity in tool work. Eventually he will naturally acquire speed from practice. It does not suffice to show him once only, but it is necessary to watch him and correct wrong methods. He should also be given some idea as to the monetary value of the piece of work upon which he is engaged, the value generally being enough to set him to thinking in tool work.

It is said that the first impressions are the most lasting, consequently the boy should spend the first six months in the tool room so as to familiarize himself with the routine of work; then six months on machine work in the machine shop; six months in the erecting shop to see and learn how tools are used in actual service; six months in treating of steel and the remainder of the time in the tool room.

A simple system of grading whereby an apprentice is kept informed as to the progress he is making compared with other apprentices on similar jobs will be beneficial.

A library which is accessible to all tool room employees is of much value. This library may contain such books as the proceedings of the American Railway Tool Foremen's Association, various hand and reference books, a great many books furnished by machine tool manufacturers and small tool catalogues. The men should also be encouraged to subscribe for good railway publications that deal with their work.

Looking at the matter from the point of view of the individual, the first need is that each man shall find something to do and do it well. He may then make a study of the conditions most likely to secure progress. The man who becomes a skilled workman or manager does not necessarily begin in the occupation in which he eventually achieves success, but he puts his energies in motion and then uses his power of initiative. Every man must learn to be thorough, to hold out. This means much concentration on the task at hand with the view of cutting down the waste, to see wherein work as well as conditions may be improved.

A man must think, acquire, control and store knowledge. If he looks around him he sees it is the man who has worked hard and faithfully who succeeds. What men need above all things are initiative, creative ideas and definite plans of action to which they can give themselves with vigor.

Everybody knows that if a positive man makes a mistake he is not long in rectifying it, but the uncertain man who never does anything without first consulting everyone else and then is always opening the question for reconsideration will never accomplish anything. Men who are made of the right kind of material do not make excuses; they work. They do not whine, they keep forging ahead. They do not wait for somebody to help them, they help themselves. They do not wait for an opportunity, they make it. Men who make opportunities are wanted everywhere.

When a man finishes a piece of work he should be able to say, "There, I am willing to stand for that piece of work. It is not pretty well done, but it is as well done as I can do it; done to a complete finish; I will stand for that and am willing to be judged by it."

In conclusion, it is necessary that in order to insure the making of a good toolroom apprentice, there must be a perfect understanding and co-operation between the apprentice and his foreman; then there will be no lost motion or wasted effort.

The report was signed by: Chairman J. J. Sheehan, tool foreman, Norfolk & Western, Roanoke, Va.; H. C. Starke, tool foreman, Union Pacific, Los Angeles, Cal.; E. J. McKernan, supervisor of tools, Atchison, Topeka & Santa Fe, Topeka, Kan.; R. R. Drake, tool foreman, Pennsylvania, Canton, Ohio, and J. C. Howard, tool foreman, Fort Worth and Denver City, Childress, Texas.

Simplification—A new tool for the foremen

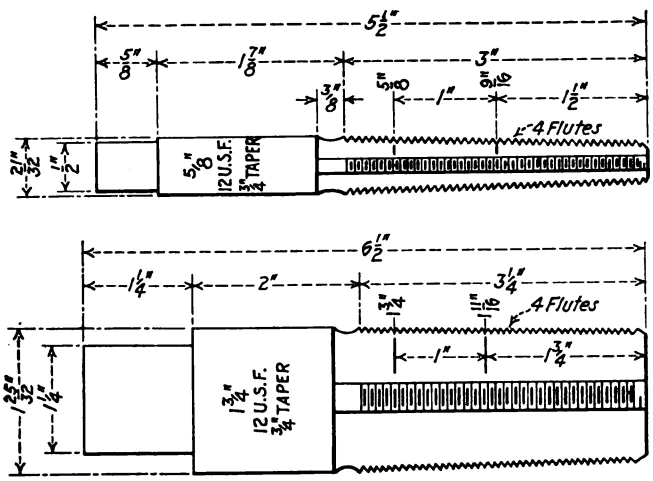
By Edwin W. Ely, Assistant Director, of the National Committee on Metals Utilization.

American business life is universally regarded from the three viewpoints of production, distribution and consumption. The tool foreman is a "producer" insofar as he shares in making possible the vast amount of passenger and ton mileage, and he is a representative "user" when it comes to consuming the tools, machines and other equipment that emanate from outside industries. In both capacities he stands in a position to enjoy the advantages of simplification—it is actually a new tool in his hands.

With a minimum variety of sizes and types of interchangeable parts entering into railroad car construction and repair, and with a reduced number of tool variations in use, the tool foreman should experience greater facility in effecting replacements and repairs. It is also reasonable to expect that the production of ton-miles and passenger-miles would be materially increased. The main objective of the tool foreman is to keep rolling

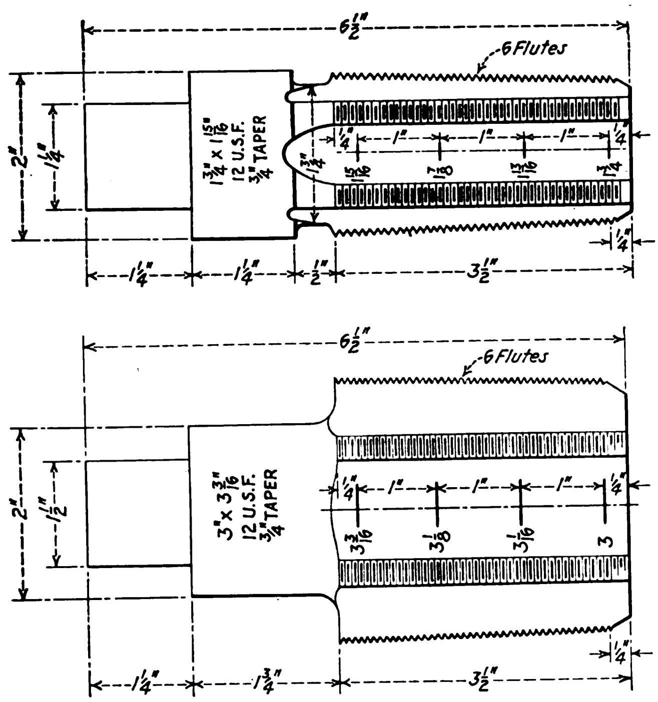
stock moving as fast, as far, and as long as possible without repairs.

Two types of opportunity offer themselves to the railway tool foreman. One is through a study of the needs of his road and how to cut down excess variety of equipment parts, tools, etc., so that stores and stocks may be



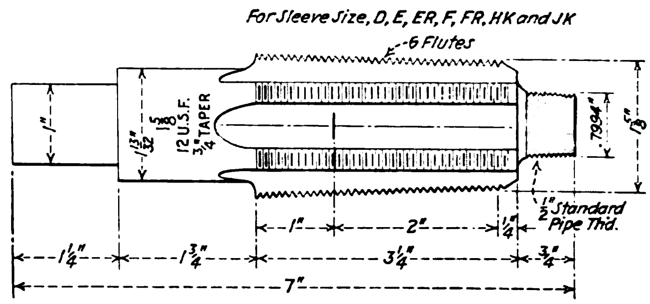
Drawings A and B—Smallest and largest of 10 sizes of taper boiler taps

reduced to a minimum compatible with adequate service. The other lies in the direction of reclamation, which practice is today saving millions of dollars annually. In the former there is an opportunity for the railway tool foreman to take advantage of, and co-operate in, a movement which is becoming more and more general through-



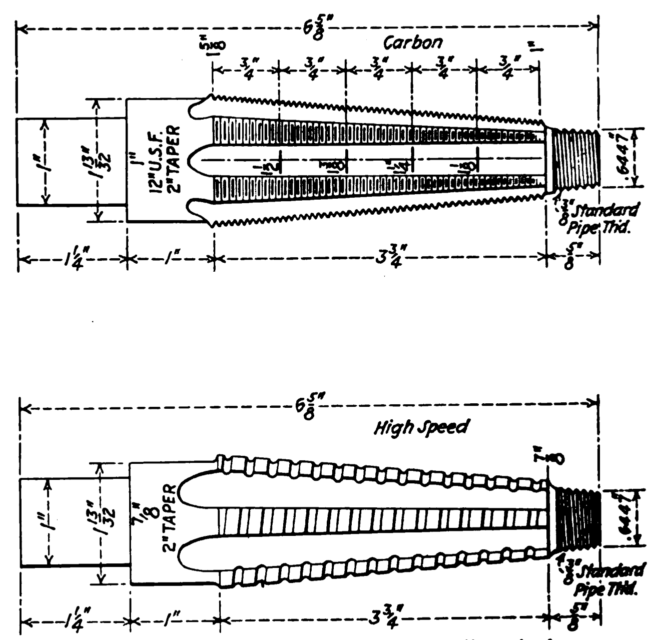
Drawings C and F—Largest and smallest of 11 proposed standard washout taps

out industry—that movement known as *simplified practice*. Simplified practice is another name for group action by manufacturers, distributers and users of any commodity, for the purpose of accomplishing three things; first, to study *all* the facts about existing variation in size, pattern, model, etc., and to acquire a knowledge of the existing demand for each of these variations; second, to determine from the available facts whether some cannot be omitted from production and use without interfering with the needs of the user, and to take joint action in eliminating the superfluous items; and third, to stick by the joint action and to watch closely the changing trends due to invention or improvement which might necessitate a revision of the program.



Drawing G—This tap proposed in 1⅝-in. 1¾-in., and 2 1/16-in. sizes

While the tool foreman is engaged in the mass production of but a single item,—mileage,—he is a user of many commodities found in the open market. As a user the tool foreman is in a position to confine his requirements to the minimum number of sizes, dimensions, varieties, etc., of the things he buys for the railroad he represents. With rhyme and reason applied to the pur-



NOTE: *After Milling cut a 4-Pitch left hand thread using a 3/32 round nose tool. Cut thread 1/16" deep*

Drawing H—Taper head radial tap and reamer

chase of stores and equipment, the foreman makes it possible for the manufacturers of the articles in question to fabricate them at a lower cost, and he places himself in a position of having to pay less for them. He may thereby reduce the size of his store-room and cut down the expense of his monthly inventory.

There are many commodities which have been passed through the regular procedure of the Department of Commerce, and which are of particular interest to the railway tool foreman as a consumer. Some of these are:

files and rasps, forged tools, steel lockers, milling cutters, grinding wheels, chasers for adjustable die heads and other small tools.

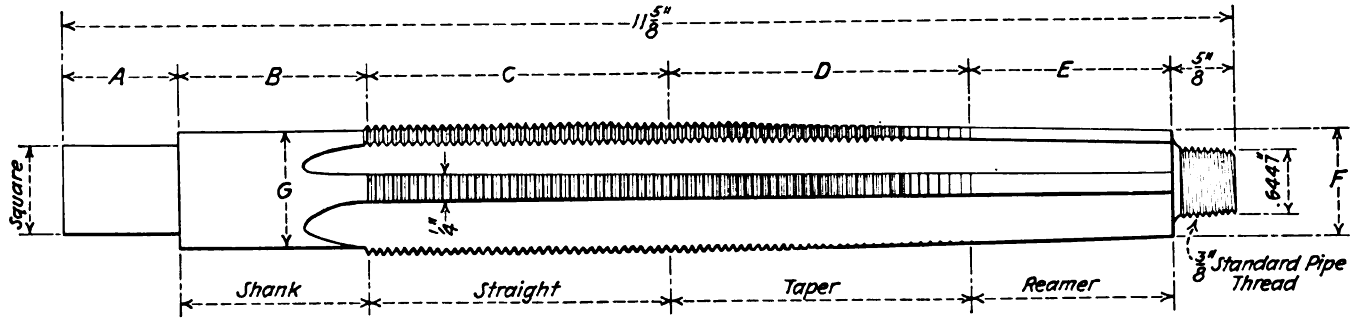
The American Railway Association has done a fine job in weeding out excess variety in such items as boiler lagging, carriage bolts, hexagon head machine bolts, square head machine bolts, locomotive boiler rivets and structural rivets. In all, the reductions amount to 1,240 out of the 1,676 previously used items.

Individual roads in the United States are making great strides in standardization matters. Some instances read like these: "eliminated 3,020 items in six and one half months," "644 items eliminated," "eliminated 4,859 items, and an active committee expects to produce several thousand further reductions," "eliminated 2,471 items in seven classes," "unable to give figures at this time, but we are in the midst of a special campaign of simplification that should produce real results."

(In closing, Mr. Ely, placed the experience and facilities of the Department of Commerce at the disposal of the American Railway Tool Foremen's Association in securing the greatest good from the constructive work that has already been done by that Association's standardization Committee, and in initiating surveys that would lead to further economies.)

Report on standardization of present special boiler taps

The object of this report is to establish standard equipment whereby the railroads may purchase standard tool equipment from manufacturer's stock instead of having it made special to individual orders at higher cost. A standards committee of the American Tap and Die Association worked with your committee in developing the standards herewith submitted, to whom we are indebted for many valuable suggestions and improvements in designs.



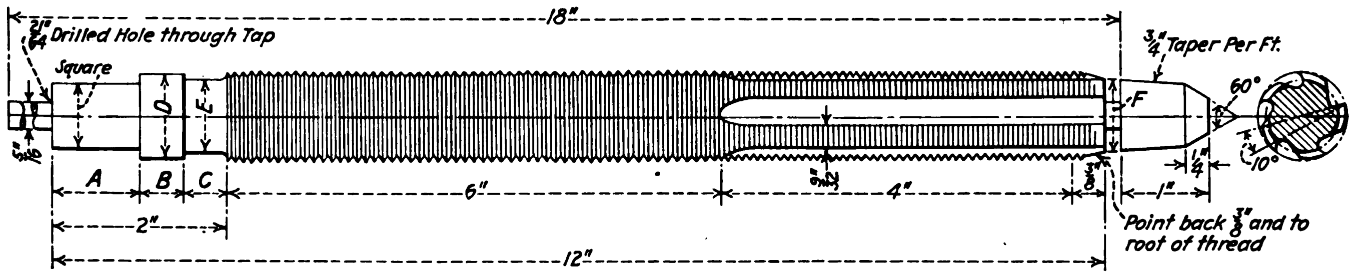
Drawing I—Wagon top pilot radial tap

Table of wagon top pilot radial tap sizes

Size	Square	A	B	C	D	E	F	G
1"	5/8"	3/4"	2 1/4"	3"	3"	2"	13/16"	7/8"
1 1/16"	5/8"	3/4"	2 1/4"	3"	3"	2"	7/8"	7/8"
1 1/8"	3/4"	1"	2"	3"	3"	2"	15/16"	1"
1 3/16"	3/4"	1"	2"	3"	3"	2"	1"	1"
1 1/4"	3/4"	1"	2"	3"	3"	2"	1 1/16"	1"
1 5/16"	7/8"	1 1/8"	1 7/8"	3"	3"	2"	1 1/8"	1 3/16"
1 3/8"	7/8"	1 1/8"	1 7/8"	3"	3"	2"	1 3/16"	1 3/16"

This proposed standardization is also in line with the recommendations made by the committee appointed by the American Railway Association as reported at this year's convention held at Atlantic City as regards their recommendations covering form of thread and taper, etc. Your committee has taken up the work where the A. R. A. left off and has gone into details of design with a view of effecting a definite standardization and higher development of more efficient tap equipment.

We recommend the adoption of the United States form of thread as the American railroad standard and the elimination of the sharp vee-form of thread entirely. The Whitworth form of thread is approved by this committee but is not recommended as a national railroad standard.



Drawing J—Spindle staybolt tap

Table of spindle staybolt tap sizes

Size	Square	A	B	C	D	E	F	No. flutes
13/16	3/4	1	1/2	1/2	13/16	13/16	13/16	5
1	3/4	1	1/2	1/2	1	7/8	7/8	5
1 1/16	3/4	1	1/2	1/2	1 1/16	15/16	15/16	5
1 1/8	3/4	1	1/2	1/2	1 1/8	1	1	5
1 3/16	7/8	1 1/8	1/2	5/8	1 3/16	1 1/16	1 1/16	5
1 1/4	7/8	1 1/8	1/2	5/8	1 1/4	1 1/8	1 1/8	5

For boiler studs and similar work we recommend taps as shown on drawings *A* and *B*. The specifications are as follows:

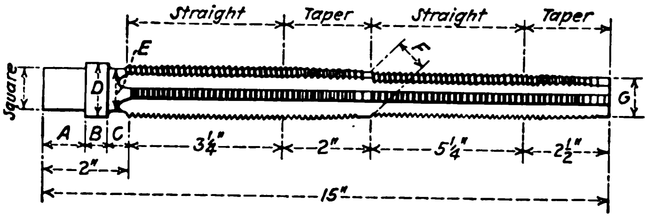
United States form of thread.
Taper 3/4 in. in 12 in.
Number of flutes—Four.
Two size lines to be plainly stamped or etched on the flute to indicate where the size is taken; this to insure the standard diameter holes being tapped.

The designs take into consideration the importance of a full thread in lapped sheets so that studs will project or be flush with the inner surface and thus avoid pockets and resultant pitting. These taper boiler taps advance in 1/8 in. steps and the design provides for proper

follow-up between taps. Attention is also directed to standardized squares, all 1/16 in. sizes being eliminated.

For washout plugs and other boiler head mountings we recommend taps as shown on drawings *C, D, E* and *F*; these taps to be United States form of thread and ¾ in. taper in 12 inches.

All taps have a standard square shank (size 1¼ in.) and an even number of flutes is provided so that the size may be taken off by calipering if desired. These



Drawing K—Combination staybolt tap

Table of combination staybolt tap sizes

Size	Square	A	B	C	D	E	F	G	No. flutes
15/16 x 1 1/16	¾	1	½	½	1 1/16	15/16	15/16	13/16	5
15/16 x 1⅛	¾	1	½	½	1⅛	1	1	13/16	5
15/16 x 1 3/16	⅞	1⅛	½	⅜	1 3/16	1 1/16	1 1/16	13/16	5
15/16 x 1¼	⅞	1⅛	½	⅜	1¼	1⅛	1⅛	13/16	5
15/16 x 1 5/16	⅞	1⅛	½	⅜	1 5/16	1 3/16	1 3/16	13/16	5
1 x 1⅛	¾	1	½	½	1⅛	1	1	⅞	5
1 x 1 3/16	⅞	1⅛	½	⅜	1 3/16	1 1/16	1 1/16	⅞	5
1 x 1¼	⅞	1⅛	½	⅜	1¼	1⅛	1⅛	⅞	5
1 x 1 5/16	⅞	1⅛	½	⅜	1 5/16	1 3/16	1 3/16	⅞	5

taps advance in ⅛ in. steps and size lines are plainly stamped or etched as shown. The design allows for proper follow-up between the several sizes and also connects up with the point where the stud taps leave off. Another reason for six flutes on all sizes is to permit a worn-out tap to be reworked into the next smaller size.

For flexible stay bolts we recommend taps as shown on drawing *G*; these taps to be United States form of thread and ¾-in. taper in 12-in., with 1-in. standard drawing shows six flutes, however, five flutes would possibly be more desirable.

Our reason for not showing a taper shank on the reamer is to overcome changing sockets in the motor. Such roads as have standardized on Use-Em-Up spindles in the air drills will no doubt prefer such shanks on both the tap and reamer.

For wagon top work we recommend the wagon top pilot radial tap as shown on drawing *I*. These taps to be United States form of thread, straight and with a ⅜-in. pipe thread pilot.

For spindle staybolt taps we recommend the taps as shown on drawing *J*, these taps to be United States form of thread and straight with the exception of the point which is tapered ⅜-in. in 12-in. with a full thread and chamfered ⅜-in. on the point to permit starting.

For combination stay bolt taps we recommend the taps as shown in drawing *K* and for the combination radial stay taps as shown on drawing *L*, which completes our recommendation.

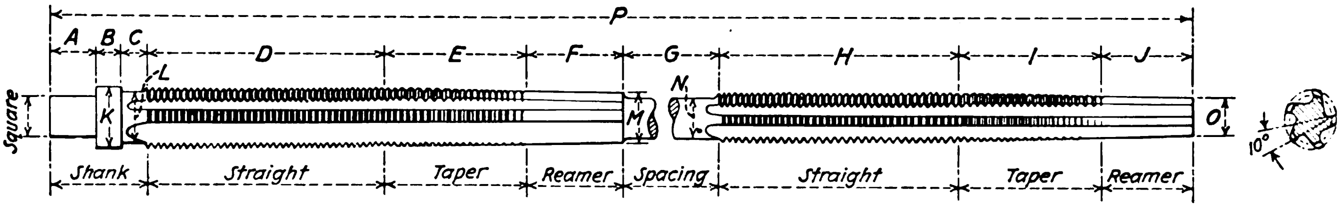
This report is of course subject to correction and it is hoped that this preparatory work will serve as a basis for final standardization. Your committee has not offered any recommendations on the straight stay bolt taps for the reason we have found a great difference of opinion as to the best design.

We hope this tap may be discussed and an agreement reached on a satisfactory standard as these taps are an item of considerable expense on every railroad.

The report was signed by O. D. Kinsey, Chairman (C. M. & St. P.); A. H. Gray (P. & L. E..); G. L. Nelson (M. S. P. & S. S. M.); F. H. Kreuger (Erie); and S. H. Ehrenstein (S. P.).

Discussion

On motion of C. A. Shaffer, general supervisor of shop machinery and tools of the Illinois Central, the association concurred in the A. R. A. recommendations of ¾-in. taper per foot, 12 threads per inch and U .S. form thread, recommending the lengths shown on drawings *A* and *B* and approving the design of taper boiler taps suggested by the committee with the exception that the taps be necked to the bottom of the thread and back a distance of ⅜-in. from the thread. This change was made to prevent damage to boiler threads on account of over-running. The balance of the taps were adopted without change except those on drawings *E* and *F*, in which it was recommended that the squares for tool shanks be increased to 1½-in. on all taps 2½-in. and over.



Drawing L—Combination radial staybolt tap

Table of combination radial staybolt tap sizes

Size	Square	No. flutes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1 x 1⅛	¾	5	1	½	½	6	3	2	0	6	3	2	1⅛	1	1	⅞	⅞	24
1 1/16 x 1 3/16	⅞	5	1⅛	½	⅜	6	3	2	0	6	3	2	1 3/16	1 1/16	1 1/16	15/16	15/16	24
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	0	6	3	2	1¼	1⅛	1⅛	1	1	24
1 x 1⅛	¾	5	1	½	½	6	3	2	6	6	3	2	1⅛	1	1	⅞	⅞	30
1 1/16 x 1 3/16	⅞	5	1⅛	½	⅜	6	3	2	6	6	3	2	1 3/16	1 1/16	1 1/16	15/16	15/16	30
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	6	6	3	2	1¼	1⅛	1⅛	1	1	30
1 x 1⅛	¾	5	1	½	½	6	3	2	12	6	3	2	1⅛	1	1	⅞	⅞	36
1 1/16 x 1 3/16	⅞	5	1⅛	½	⅜	6	3	2	12	6	3	2	1 3/16	1 1/16	1 1/16	15/16	15/16	36
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	12	6	3	2	1¼	1⅛	1⅛	1	1	36

square heads; all taps to have six flutes and a ½-in. pipe thread pilot. The object of a pipe thread for the pilot is that, being taper and a fine thread, it is stronger than a coarse straight thread such as is usually furnished; also a common piece of pipe and a coupling will serve as a pilot.

For taper head radial stays we recommend the tap and reamer shown on drawing *H*. These taps to be United States form of thread, 2-in. taper in 12-in. with 1-in. square head and ⅜-in. pipe thread for pilot. This

General foremen meet at Chicago

Importance of modernizing shops stressed—Foreman and apprentice training recognized as vital factors

THIS year's attendance and the excellent papers and addresses presented at the convention of the International Railway General Foremen's Association, held at Hotel Sherman, Chicago, September 7 to 10, inclusive, indicate an increasing interest in the activities of this organization. A well balanced program, speakers of recognized ability in railroad work and a keen interest in the discussion tended to emphasize the success of the officers of the association in their efforts to make the organization a factor in establishing the importance of the general foreman's position in the mechanical department.

Addresses were delivered by E. L. Woodward, western editor *Railway Mechanical Engineer,* L. C. Dickert, superintendent motive power, Central of Georgia, D. C. Curtis, chief purchasing officer, Chicago, Milwaukee & St. Paul, F. H. Becherer, superintendent car department, Central Railroad of New Jersey, and M. A. Hall, superintendent of machinery, Kansas City Southern. During the seven sessions of the convention papers were presented and discussed on the following subjects: Balancing Shop Sub-Departments in Locomotive and Car Departments; Development of the Mechanic; Maintenance of Refrigerator Cars; The General Foreman's Responsibility for Material Surplus or Shortage; Developing Railroad Shop Foremen; and Modern Shop Equipment as a Factor in Increased Production.

Election of officers

The following officers were elected to serve during the year 1926-27: President, C. A. Barnes (Belt Railway of Chicago); first vice-president, F. M. A'Hearn (Bessemer & Lake Erie); second vice-president, J. N. Chapman (Illinois Central); third vice-president, C. F. Bauman (Chicago & North Western); fourth vice-president, J. H. Armstrong (A. T. & S. F.), and secretary-treasurer, William Hall.

Abstracts of some of the addresses follow and others will appear in subsequent issues of the *Railway Mechanical Engineer:*

Possibilities of the General Foremen's Association

By E. L. Woodward
Western editor, Railway Mechanical Engineer

The possibilities of the International Railway General Foremen's Association for promoting better railroading are so closely allied with what general foremen individually and as a class can do as to be practically incapable of separate discussion. No distinction will therefore be made in this paper. General foremen are responsible to no inconsiderable extent for the efficiency with which Class I railroads in the United States spend over $1,200,000,000 annually for maintenance of equipment. About 60 per cent of this amount is for labor in repairing cars and locomotives—and the general foreman is primarily a co-ordinator of labor, with the first duty of getting his men to work efficiently and together. Forty per cent of maintenance-of-equipment expenditures is for material—and on the general foreman's judgment depends to a considerable extent the saving or waste of material.

The increasing responsibilities of general foremen are evident from an examination of Table I which shows that for one reason and another the cost of keeping cars and locomotives in serviceable condition on American railroads has trebled in the past 15 years. Locomotives have increased 10 per cent in number and 60 per cent in total power during that period. Freight cars have increased 11 per cent in number and 35 per cent in total carrying capacity. Wages have gone up and hours of labor per day gone down. Will the cost of maintaining cars and locomotives continue to mount, or will the concerted efforts of general foremen and other mechanical department officers and supervisors be successful in reducing it? That the increase has been checked at least temporarily is shown by the close similarity of the 1924 and 1925 figures, but probably no general foreman will dispute that, taking the railroads as a whole, substantial reductions in present maintenance costs can be made without decreasing either the quantity or quality of the work. This should be the general objective of the International Railway General Foremen's Association and of the individual members who compose it.

Table I.—Maintenance-of-equipment expenses, Class I railroads, labor and material

1911	$415,590,400	1919	$1,226,532,195
1912	436,995,458	1920	1,590,364,640
1913	499,988,331	1921	1,251,479,444
1914	520,200,274	1922	1,249,038,676
1915	496,739,561	1923	1,462,222,167
1916	557,664,332	1924	1,256,369,892
1917	685,428,913	1925	1,256,378,353
1918	1,103,031,350		

Some additional figures of interest bearing on the number of men supervised by railway general foremen are shown in Table II, these figures being furnished, as are those in Table I, by the Bureau of Statistics of the Commerce Commission.

Table II.—Number of men on Class I roads in 1925, supervised by general foremen

General foremen (maintenance of equipment)		1,498
Assistant general foremen and department foremen		11,648
Machinists		9,229
Blacksmiths		61,265
Boiler makers		19,802
Car men		
Class A	22,447	
Class B	4,445	
Class C	87,086	
Class D	2,278	
Total car men		116,256
Total employees on daily basis		17,026
Total employees on hourly basis		507,486
Total labor cost (M. of E. in 1925)		$805,085,910

It will be noticed that this table shows 1,498 general foremen employed on Class I roads and, for maximum effectiveness, the International Railway General Foremen's Association should have a membership at least approaching that figure. In fact, it might be even more, as the assistant general foremen and some of the department foremen may well be considered eligible for membership.

Membership of 500 not final objective

I recall distinctly that the first thing President Warner said, after accepting his re-election last fall was, "let's get to work." This was characteristic, and he, in conjunction with Secretary Hall and the other association

officers and committee men have labored many hours to make this convention the largest and best ever held by the association. They arranged the program which is, I think, notable for the importance and diversity of the subjects considered, as well as the number of ranking mechanical department officers secured as speakers. They set an objective of 500 members in attendance this year which is very creditable but must be considered only a step in the right direction if this association is to achieve the power and influence possible of attainment by it in the railroad world.

Another striking fact shown in Table II is the great preponderance of car men over any other classification. Locomotive men may take precedence in mechanical department councils because, without motive power, trains cannot move. It is equally true, however, that locomotives are valueless as revenue earners without cars, and there are 2,358,000 freight cars in service on Class I railways as compared to 64,150 locomotives. The task of maintaining these cars efficiently is a tremendous responsibility of railway general car foremen, whose problems and difficulties deserve a large share of the time and attention of this association.

General foremen must study men

The general foreman's main problem, and therefore a subject for discussion by this association, is that of men—their selection, training and handling. Apprentices must be watched and encouraged, helpers promoted, mechanics advanced, department foremen developed and induced to work together in harmony.

The general foreman who thinks long years of experience have taught him all there is to know about this subsubject is fooling no one but himself. Some of the brightest minds of this generation are devoting their entire time to solving problems of personnel, and their observations and findings are available in a broad way in books and magazines, more intimately by personal contact with the authors. It is doubtful if any general foreman is living up to his full possibilities unless well read on this subject of personnel handling.

Moreover, it is becoming the function and duty of general foremen to combat false propaganda among workmen by giving publicity on bulletin boards and at shop meetings to the real facts about railroad operation, costs, taxes, earnings, etc. Accurate information secured from the management and properly broadcast to shop men will do much to improve their morale, make the shop atmosphere more conducive to efficient work and increase shop output.

Shop methods are a distinct responsibility of general foremen, and much of shop efficiency is dependent on the methods selected, the way work is routed or scheduled from one department to another, the machinery chosen for specific operations. General foremen need to attend this and similar conventions, visit other shops and read all the pertinent literature available to keep up to date on methods. And it must be admitted that in at least some railroad shops it is not so much a question of keeping up to date as getting up to date.

Machinery and shop equipment should receive the special attention of general foremen who are in a strategic position to furnish data proving to higher executives the justification for buying more powerful, modern machines. Since 1911, locomotives have increased approximately 10 per cent in number and 44 per cent in average power and weight. Locomotive accessories have multiplied rapidly, and yet the attempt is being made to maintain this modern power in many shops and enginehouses built in 1911 or before and improved little if any since. Similar conditions obtain at many car shops where the situation is aggravated by the attempt to repair steel cars in shops originally designed to handle wooden cars only. This subject of steel car repairs is a vital one at the present time. General foremen may feel that if their immediate superiors are apparently uninterested in improved facilities "they should worry." The answer is that, being closer to the work, they are in a better position to know just what antiquated shop equipment is costing the railroads.

Next to stabilization, new wage system is most important need

The installation of modern machinery and up-to-date schedule systems may bring about a marked improvement in shop operation and increased output. Experience has shown that the operation will still be only about 66 per cent efficient, however, unless the present common system of daily wage payment is replaced by some method of paying men in proportion to the work they do. This is the greatest need of railroad shops today, next to stabilization of employment. Attempts are being made at a number of points to solve the problem, in some cases by piece work and in others by some form of bonus system. General foremen should keep in touch with these developments and be prepared to advise their managements what type of wage payment system will probably best meet the needs of their individual shops.

Another crying need in many railroad shops today is a more accurate computation of the locomotive repair, car repair and shop order work on a man-hour basis. This is necessary to a real knowledge of costs and checking of the relative efficiencies of various methods and departments. The progressive general foreman wants to know exactly what conditions are in his shop and how his operation this year compares with last. The answer is to compile labor records on a man-hour basis.

Put equipment through the shops faster

Still another subject of intense interest to higher executives at the present time is the utilization of railroad equipment. A modern locomotive costs, roughly speaking, $80,000, a passenger coach, $40,000 and a freight car, $3,000. Every day this equipment is in the shop for repairs it not only earns no revenue but incurs a substantial interest charge. Some roads are taking 30 days or more for Class 3 repairs to locomotives, including new flues and heavy repairs to machinery. Passenger cars are in the shop 25 days or more for heavy repairs and burning off old paint. The possibility of having a fewer number of cars and locomotives in any given shop at the same time, working a larger number of men on each unit of equipment and putting the equipment through the shops on shorter schedules may well be considered by the railroads as a whole and by this association.

This paper will be closed with a few suggestions "for the good of the order" which may be summarized as follows: The International Railway General Foremen's Association needs (1) a larger and more representative membership from railroads in the various sections of this country, (2) continually better convention programs, (3) more intensive work by committee members other than chairmen, (4) more critical and general discussion of committee reports, (5) more definite action on important questions at issue, (6) more widespread publicity for the work of the association and (7) a keener appreciation of the possibilities of the association and of its individual members in the more efficient spending of the railroad dollar. It is not common for any man to underestimate the importance of his own job, but somehow general foremen frequently get so bound up in details

and so close to their individual work that they lose all sense of perspective and fail to see how their efforts can best fit in with those of other mechanical department officers.

To achieve the seven objectives outlined in the preceding paragraph, the best brains of this association should be mobilized in a committee, each objective studied in detail, suggestions sought from the entire membership and from outside friends, and a program of work laid out which will make this association the power it ought to be for better railroading in this country.

The development of the mechanic

By C. L. Dickert
Superintendent of motive power, Central of Georgia, Savannah, Ga.

Which produces the best results, regular apprentices, helper apprentices or train specialists? This subject has been before the railroad world for many years and has aroused great interest and called forth much discussion.

This is particularly true in the case of the college educated man. There have been many articles written pro and con on this subject and, while it is true that college men have made failures, it is not due to the college education, but to the individual himself. Physique, mentality, morals, and mechanical experience being equal, the college educated man has a distinct advantage over the non-college man. I refer, of course, to the technically educated college man.

In support of this statement, I might quote from an article I read recently in the Railway Age concerning the college man's chances: "In the last four years thirteen of the most important railroad companies have elected new presidents. Of the retiring presidents of these railways only two were college educated men. On the other hand, of the thirteen new presidents, seven are college men and only six are non-college men."

I must admit that there are at present many men who are non-college men, that have risen to high positions, but the college man is fast coming to the front. I do not mean to say that the non-college man has no chance, for he has, but the fact remains that there is a growing demand that he be broadly educated. The boy who through no fault of his own has had no chance to get an education beyond grammar-school may go in the shop and become a first class machinist, boilermaker, etc. As a machinist he may be able to handle any machine known to a railroad shop. He may be able to go into the erecting shop and do perfectly any of the different things which are necessary in the erection of a locomotive. He may develop into a good executive and may finally become a foreman, a general foreman or a shop superintendent. On the other hand, suppose we have a technically educated boy, who has all the qualifications of the other. Of the two, who should make the best superintendent of motive power?

Up to a certain point the non-college man has equal chances with the college man, for, as a machinist, boiler maker, blacksmith and on through the list, everything being equal they are told what to do and knowing how and both do it to the best of their ability. Their responsibility ends when the job is done. As a gang foreman or assistant foreman, they are generally directed and guided by the foreman in charge, or should be. Up to this time both of them have opportunities to show their natural ability, but as they go on up, they meet more and more mechanical problems which have to be solved and surely the technically educated man must naturally have the advantage. Assume that these two boys, after a certain length of time are sent to the drafting department which one is going to be the most efficient in working out the many problems which arise and which in many instances, require a knowledge of higher mathematics?

I have, at various times, while reading articles on the question of the college man in railroad work, seen the statement that college graduates fight shy of the railroads. This may have been true in the past and to some extent at the present time, but why? Owing to the fact that railroads in general have paid very little attention to the education of apprentices in the past, there has been very little inducement offered the college man and then again, because the average college man is very ambitious and desires to start at the top. This, of course, is where he makes his mistake. He realizes that he has spent four years in college and when he finds he must spend approximately the same time in the shops before he can become an educated mechanical man, he becomes discouraged. This condition can be overcome by the co-operative system which we have in operation on our railroad.

This system has been in operation only three years with us, but we feel that it is going to produce splendid results. It is operated in conjunction with the Georgia School of Technology, this school having taken up the co-operative plan in 1912, when they had an enrollment of twelve. In 1925 the enrollment was 330.

Personally, I think the co-operative plan preferable to the regular insofar as the mechanical student is concerned, as it enables him to combine his practical experience with technical theory, and thus be prepared to start out in the mechanical world well equipped.

A very important feature of the co-operative plan is the fact that the boys come in daily contact with their fellow employes who have not had the opportunity of going to college. An insight into sociology, economics, ethics and psychology may be had by this contact with their fellow workers, which could be obtained in no other way and at the same time the student is learning what a shop and railroad is.

The co-operative students are divided into two groups or sections, and while section one is at college getting their class room work, section number two is at work in the shops. At the end of four weeks this order is reversed. The course extends through five years, the student being allowed only three weeks' vacation, two in the summer and one during the Christmas holidays. These students not only go to college through five years, but they put in more hours daily, as they have 30 weeks a year at school, while the regular student has 36 weeks a year in his four-year term.

In order to enter college, these boys must be graduates of an accredited high school or its equal and the railroad company doesn't consider any student unless he has fulfilled all of the college's conditions. When the student has been accepted by the college and the railroad, he is then assigned to one of the shops most convenient for the student. In other words, he is assigned to a shop, if possible, in the city in which he lives. This, of course, cannot be done in every instance and the student who cannot be so located has to pay expense at both ends.

You will understand, of course, that the co-operative student is paid for his time while at work, his rate of pay depending on the industry or corporation with which he is working. In some cases these boys are able to pay practically all of their expenses, particularly after the first year, but these cases are few, and depend largely on the individual. As you may know, this plan is particularly helpful to the boy who cannot afford to take the

regular course where he is at a dead expense, so naturally, they take the co-operative plan on account of the financial aid they receive, but I am sure as time goes on the mechanical students of the future will realize the superiority of this plan over the regular course as mentioned before.

We have at present, 84 of these students, 42 per section divided between four shops in proportion to the size of the shops and the amount of work done. They are entitled to all the privileges of the regular students at college and to those of all other employees of the railroad company.

Their time is divided between all departments of the shop, the foreman in charge being the judge as to when a change is to be made. Here, of course, arises a problem, for where one student might become proficient in a certain length of time, another one may take twice as long. These and other problems connected with the plan will, of course, be smoothed out in time. In addition to shop work, these boys spend a certain length of time in the drafting department and the testing laboratory. In fact, it is our idea to give them a complete shop education and when they graduate, we will pick such as we desire to perfect, and carry them along with the idea of producing supervisory material.

At present we are developing two grades, mechanical and electrical, our plan being to combine the two for three years. At the end of three years the student can determine whether he wishes to follow the mechanical or electrical line and we feel that with three years of general shop work he should be able to perfect himself in the work he wishes to pursue.

Our company starts these students in at a liberal rate of pay and give them an increase every six calender months.

While this plan was started on our road only three years ago, we have five boys who graduated in June, having served two years with other industries before the Central of Georgia took up the plan. We decided to take the five in our service and at present one of them is employed in the test department and handles the tensile test machine, makes coal analyses and other work of like nature. Another of these boys is being used in our largest shops in doing special engineering work. The other three elected to perfect themselves in erecting shop and roundhouse work.

This plan does not eliminate the regular apprentice, and we continue to take in these boys. We still feel that the non-college man must have his chance and we are, therefore, giving him the opportunity to prove his worth. If the boy is ambitious and wants to progress through work and study, we provide the means, as we conduct an apprentice school through the winter months. We have as instructors in this school, teachers from the manual training department of the local high schools together with certain of our foremen, and the boys are taught drawing and elementary mathematics, as well as certain principles concerning locomotives, cars and shop work in general.

Discussion

In discussing Mr. Dickert's paper, T. C. Gray, supervisor of apprentices, M. K. & T., directed attention to the fact that the three classes of apprentices—regular, helper, and special—serve three distinct purposes. He mentioned the fact that the helper apprentice on the M. K. & T. is gradually being eliminated. He expressed the opinion that from the ranks of the regular apprentices should come the skilled mechanics, shop supervisors and, in some cases, higher mechanical officers. The training of special apprentices, however, should be directed to the production of technical experts and an occasional mechanical engineer and superintendent of motive power. "It seems to me," he said, "that the two aforesaid classes of apprentices fill a much needed want and the training problem is of much more importance that the question of the relative value of the two. Mr. Dickert does not say that it is essential that a gang foreman be a technically trained man. This does not leave many places demanding a technical education. It would be interesting to know the number of special apprentices that could be taken care of in a period, say of 10 years."

Mr. Gray took exception to the value of training apprentices in the drawing room. He pointed out that while it is especially desirable that a machinist develop the ability to read working drawings accurately and rapidly, it is much more desirable to devote the greater part of his training to the development of skill in practical work. He emphasized the desirability of training apprentices to make accurate sketches, rather than finished working drawings.

C. Y. Thomas, supervisor of apprentices, K. C. S., was of the opinion that the apprentice training method in effect on the Central of Georgia as described by Mr. Dickert would tend to develop more technically trained men than a single road could possibly make use of. His remarks indicated that he felt the most important function of apprentice training should be to develop a sufficient number of practical mechanics who, through further training, could be developed into supervisors and that the railroads should draw from the colleges the technically-trained men that are needed in their organizations.

Committee report—Material surplus or shortage

The office of the general foreman in the railway shop is, to a certain extent, an auxiliary to the purchasing and stores department. The general foreman's position is such that he is enabled to help or to hinder the efforts of the stores department in giving satisfactory service by having necessary materials on hand at all times, without having an accumulation of slow moving or obsolete material.

A survey of material cost against locomotive mileage shows that in classified repairs the material cost may run in excess of 50 per cent of the labor cost, while in running repairs it may be as low as 10 per cent of the labor cost. Probably a conservative estimate would be 60 per cent labor and 40 per cent material during the service life of the locomotive. This percentage, while varying due to the size of power units and local conditions, may safely be taken as at least 10 cents per locomotive mile run for locomotive material. From information available we believe that $10,000,000 a month is a low figure to represent the expenditure for materials used in locomotive maintenance of the railways of the United States. It therefore follows that, if it lies within the power of the membership of this organization to effect a substantial reduction, either in the amounts of stock carried or in the amounts actually drawn for use, it is important that the efforts be made.

On December 31, 1920, shortly after the end of federal control of railroads in the United States, Class 1 railroads had in stock material with estimated value of $755,563,278. At the end of 1924 the value of material held in stock by the same railroads had been reduced to some $530,000,000. An approximate reduction of 30 per cent was accomplished during the four-year interval.

A few words as to the cost of carrying surplus material for railroad shop use might be of interest. Investigation gives some variations in opinion upon this subject. U. K. Hall, general supervisor of stores, Union Pacific System, recently made the statement at Atlantic City that "The consensus of opinions of experts who have studied this subject has been that it costs from 15 per cent to 25 per cent to carry material." Mr. Hall at this time also submitted an itemized division of the costs as shown by R. M. Hudson of the United States Department of Commerce at Atlantic City on June 10, 1925. Mr. Hudson's estimated charge was 25 per cent. Some railroad representatives who have been questioned upon the subject estimate from 10 per cent to 20 per cent. We submit these figures merely to show that slow moving materials for which the general foreman is in a measure responsible, are a greater cost to the transportation companies than might appear to the mind of the average mechanical man. As to material shortage, each and every general foreman knows only too well the cost of shop delays brought about by inability to secure material when needed. The desired position and relations between the mechanical department and the stores department would be a quick turnover of materials for the stores department interests and an ample supply of materials at all times subject to the demands of the mechanical department.

An interesting light upon amounts of materials needed is shown in the answer of I. H. Lance, general storekeeper, D. L. & W., to the inquiry of your committee which eliminates one of the most popular excuses that an increase both in the number of items carried and in the total value of items carried was an inevitable part of the growth of modern locomotives and cars. We learned that this road on July 1, 1918, carried 58,000 items of material. June 1, 1926, these items had been reduced to 38,000. We quote our authority literally in this statement "This reduction in the number of items carried in stock resulted from standardization and elimination from stock of items which we found it unnecessary to carry.

"My experience * * * indicates very clearly that a mechanical department, as well as other departments, are not likely to call attention to surplus materials, but, on the other hand, they are very loud in their complaints when a shortage exists. This, however, does not apply to our road as we have the utmost co-operation of our department heads, and this is one of the reasons we have been successful in reducing our stock balance. If it is made known by one in authority to foremen in a mechanical department, or any other department, that they must interest themselves in materials for the purpose of eliminating surpluses and avoiding shortages as far as possible, I think this would be a good beginning.

"In the beginning foremen will undoubtedly show indifference, but if the proper pressure is brought to bear, they will soon realize they have a responsibility in assisting to maintain a minimum stock. Of course, we, like all other railroads, have a stock book which shows the movement of materials and this is a very good weapon to use when showing foremen when materials become inactive and when unnecessary to carry in stock. Of course, there are certain items of materials that must be carried for emergencies which are more or less inactive. With changing conditions it is absolutely necessary that materials be constantly checked with the departments using them and I have described above our methods of doing this and I attribute to this constant checking a good share of our stock balance reduction."

A periodical examination of stock lists and issues in order to detect slow moving or non-essential material seems to be a duty of certain mechanical department representatives. There are representatives on many roads that have shown notable results in stock value reductions. Mechanical department representatives may see many opportunities in the course of their work to divert slow moving materials into channels where they will be used. Minor alterations of slow moving or obsolete castings or parts will often enable their disposition by other means than as scrap.

Standardization of parts cannot be too strongly stressed. Probably no one other action taken by the mechanical department will make for the solution of the material problem under discussion more than this one.

Utilize to the fullest extent the aid and advice of service men of the various supply companies in matters pertaining to their own particular products. The suggestions of these specialists will often serve to avoid unnecessary renewals of parts discarded through lack of proper judgment on the part of the mechanic or removed as a matter of shop routine. Careful workmanship at repair periods and proper maintenance and proper supervision of right repairs will greatly increase the service of equipment between shoppings and inevitably secure a longer service life of the parts that compose the equipment unit.

Use of modern repair methods in the application of long service materials to various wearing surfaces, as for example, bronze wearing surfaces on cast iron cylinder or valve tee rings, bronze or steel removable plates on driving boxes, and any other repair methods that are practiced to certain extents in some shops, but do not become general practice in all shops as rapidly as they should.

There is a decided variation in shop practices in the matter of establishing wear limits to locomotive parts. While it would not be practicable to say, for example, that all locomotive driving box bearings for power of certain sizes should be run to some arbitrary condemning limit, one usually finds that practice in the matter of scrapping such wearing parts is subject to wide differences of opinions.

Another angle of this variation in shop practice is found in the method of some roads of re-boring worn locomotive valve bushings once only, and to whatever size they will make up, contrasted against other roads that have reamers varying by 1/8 in. in size; by which means valve bushings are re-bored three times. Still other roads may establish a wear limit the same as mentioned in the second case, but may vary their sizes by sixteenths instead of eighths. It is certain that some of these practices possess advantages over others.

We find that locomotive and car department general foremen by assuming their share of responsibility for material surplus and shortage have effected savings in many ways. Shop delays, unnecessary items, inactive stocks, obsolete parts, and serviceable materials being lost as scrap are all being lessened through their efforts. At the same time a closer understanding between departments work for a mutual betterment for all involved.

The report was signed by F. M. A'Hearn, chairman, B. & L. E., Greenville, Pa.

The Baltimore & Ohio has advanced the pay of shopmen from one to two cents an hour; and work on Sundays and holidays, performed by men not regularly on duty on such days is to be paid for at the rate of time and one-half. The increases which went into effect September 1, include machinists, boilermakers, blacksmiths, sheet metal workers, electrical workers, car men, car cleaners and preparers, and apprentices in all classes.

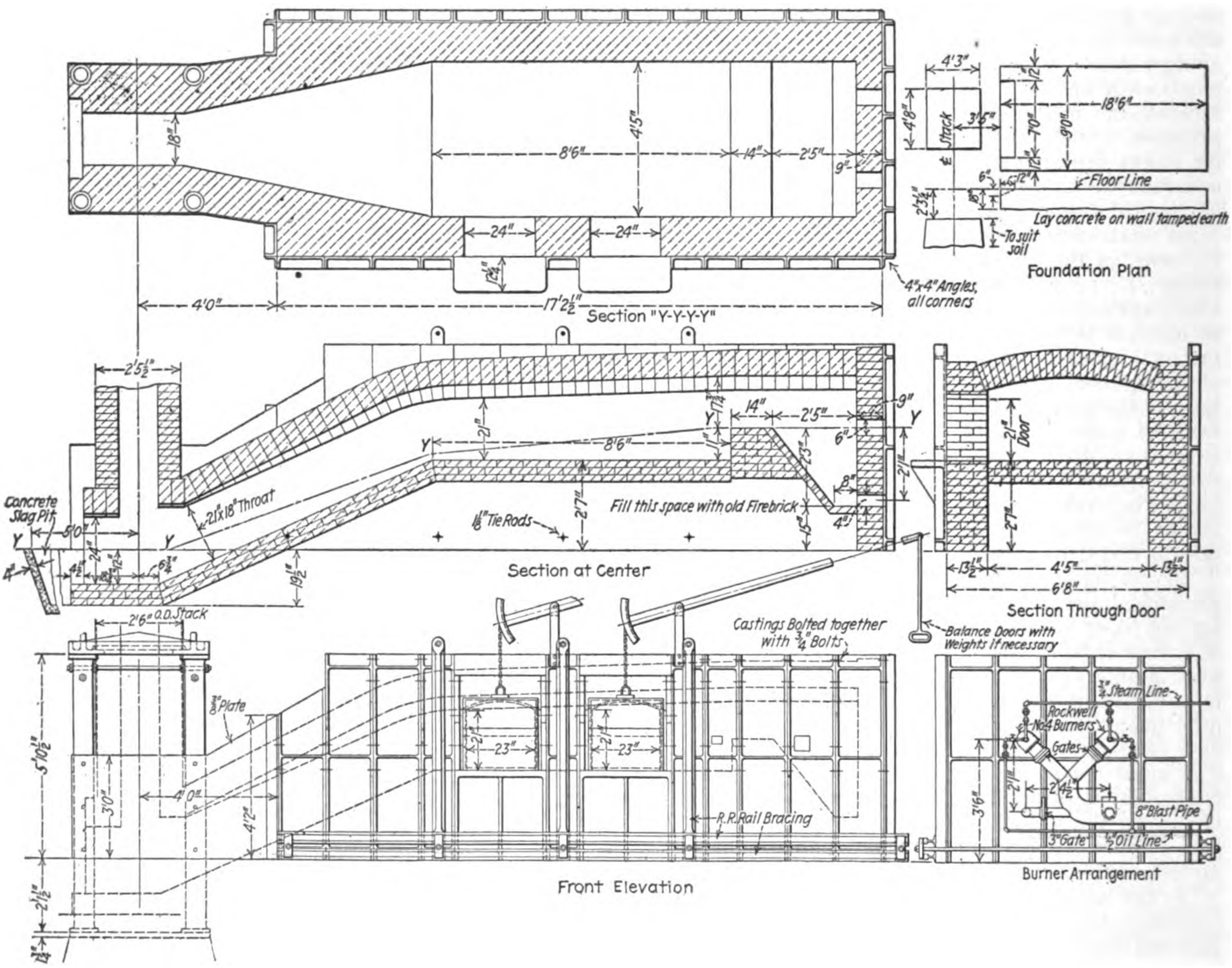
Economically operated forging furnace

By Glenn L. Davis

The design of forging furnaces is always the subject of much discussion and speculation in the drafting rooms of railways that design and build this part of their forging equipment. This condition is not entirely due to the lack of data on the subject, or because manufacturers of furnaces have lagged behind other industries in research work, but is due mainly to the fact that furnace troubles are frequently due to the condition of the outside of the furnace rather than to mistakes in design. This statement must be construed to mean that such conditions as irregular blast pressure, faulty building ventilation, poor fuel improperly supplied, the use of the furnace for heating cumbersome pieces for which it is not adapted and poor setting or bricking of the furnace, will bring on heating troubles more often than will poor designing, which to a great extent, can be detected and remedied before the furnace is built.

Nearly everyone who has to deal with forging problems knows too well, all of the usual difficulties which arise in the day-to-day operation of forging furnaces. These difficulties may be briefly enumerated as follows: first, uneven heating of the work owing to hot and cold spots within the hearth or heating chamber; second, excessive oxidizing of the work on account of improper combustion within the hearth; third, flare-out or excessive heat at the charging doors of the furnace, making charging, removal and heat gaging difficult, and fourth, excessive operation and maintenance costs caused by one or the other of the defects listed above or to a combination of these defects.

Having all of these possibilities in mind, the average designer of shop facilities who is concerned with forging furnaces only occasionally, usually looks about for some type of furnace that has functioned with a minimum of trouble under average conditions and copies it with such minor modifications as are necessary to his particular needs. Such a furnace—one that has demonstrated its worth in hard service over a period of many months—is shown in the accompanying illustration. It is an oil-fired adaptation of an older type of down-draft, coal burning forge. It has the usual bridge wall for the baffling and distribution of the heating gases and the rectangular hearth or heating chamber with sloping roof, double charging doors and down-draft conduit leading to the stack. The brick walls and cast iron casing of the furnace as well as the burners, blast piping and doors are of the conventional type.



Working drawing of a forging furnace designed for economical operation

Particular attention is called to the setting of the burners with the center lines on a level with the top of the bridge wall and also to the arrangement of the auxiliary blast piping under the burners to direct the gases upward and cause them to impinge against the sloping roof. This arrangement of the burners, blast and baffle insures an

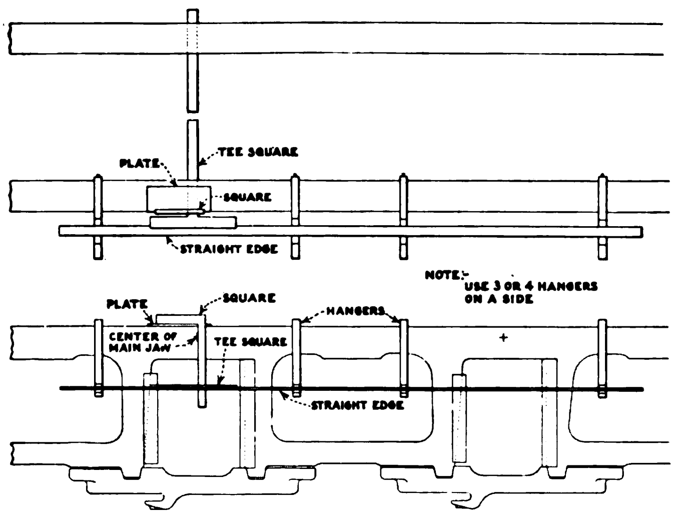
even distribution of heat within the hearth and, since there are no hot and cold spots within the hearth, the lining and casing of the furnace are not subjected to excessive strains with their corollaries of cracking, warping, etc. Hence, the maintenance costs on these particular hearths are low.

Another feature in the operation of this furnace has been the almost complete freedom from flare-out. In handling such work as old axles or billets which must extend beyond the doors while being heated, it has been found necessary to use a minimum of luting around the work. Generally, old fire bricks laid so as to seal the opening under the half open door, have been satisfactory as a seal, without the addition of dirt, cinders or other material. While the first cost of the furnace shown, because of its length, may seem objectionable to some designers, it must be remembered that the final economy of any facility, measured by demonstrated service is a far truer index of actual cost than the figures denoting the initial outlay.

According to the builder of this furnace, who is a blacksmith foreman of long experience, it is inadvisable to attempt to scale down the dimensions on this plan in an attempt to build a furnace of, say one-half the hearth capacity of the one shown. Height of bridge wall, distance of burners from the wall, dimensions of draft conduit, etc., are all subject to minor variations to suit local conditions and while furnaces built to the sizes shown have proved their worth in various localities and under varying conditions, the drawing must still be regarded as representative of a simple, effective type, rather than a specific recommended installation for all blacksmith shops. It must be noted, too, that attention to little details, such as hooding the stack at night to prevent back draft and subsequent cracking of the stack lining, has probably helped in establishing the good service record of this furnace.

Laying out shoes and wedges

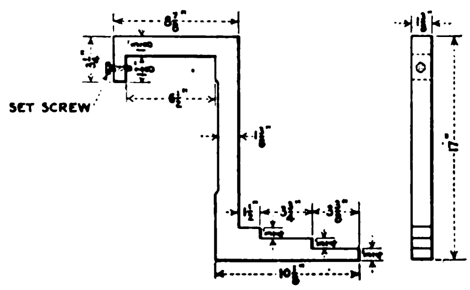
The method employed on a mid-western railroad for laying out shoes and wedges incorporates the use of long straight edges, held in position along both sides of the frame on hangers, a detailed drawing of which is shown in one of the illustrations. Three or four hangers are



Method of holding a straight edge along the frame jaws when laying out shoes and wedges

located at convenient places along the frames and held securely by set screws. The three hanger steps provide for setting the straight edge out beyond the brake hangers or other castings on the frames. The straight edges must be set parallel with the frames.

After the straight edges are in position, the distance from the face of the cylinder to the center of the main jaw is obtained from blueprints. This measurement locates the center of the main jaw, which is marked about two inches down from the top of the upper frame rail, as indicated in the illustration. The corresponding center must then be located on the other frame. In order that the square will set properly, the top of the frame is scraped and a plate used on which the butt of the square rests. By placing the square on the jaw center line, it is transferred down to the straight edge. The T-square, having a shoulder on its head which rests on the top of the straight edge, is then held against the straight edge and brought up against the square, after which the same square



Detail of the hanger for supporting the straight edge along the side of the frame

is similarly used on the other side to transfer the line to the top frame rail.

In order to prove that the frames and jaws are square, the above operation is repeated for the frame on the opposite side. The lines thus made should check, otherwise the T-square or the square are not accurate or the top of the frame may be warped.

The centers of the other jaws may then be located, according to the rod lengths, by tramming from the centers of the main jaws, and the shoes and wedges laid off in the usual manner.

The engine truck center casting and the trailer lead pin casting are marked and located accurately. Both the engine and the trailer trucks are known to be square before they are placed under the engine. A gage is used for turning the tires and all contours are thus made the same. From a center located between the faces of each axle, the hub liners are trammed to insure their being identical. If not, they must be made so.

The spring saddles, driving boxes and springs are checked to be sure that the distance from the top of the journal to the spring seat is the same in all cases. The equalizers are drilled on the same centers, as are the spring hangers.

An important operation is that of checking the springs for height when free, depressed one inch and for total load. This check is made on a spring tester. If any spring is found which does not test to the requirements, it is re-set so as to conform with the others. Old springs are tested and paired so as properly to distribute the weight on both sides of the engine.

When the engine is ready to leave the shop, it is placed on a stretch of straight level track and the distances from the rail to the springs are checked to be sure that they all correspond.

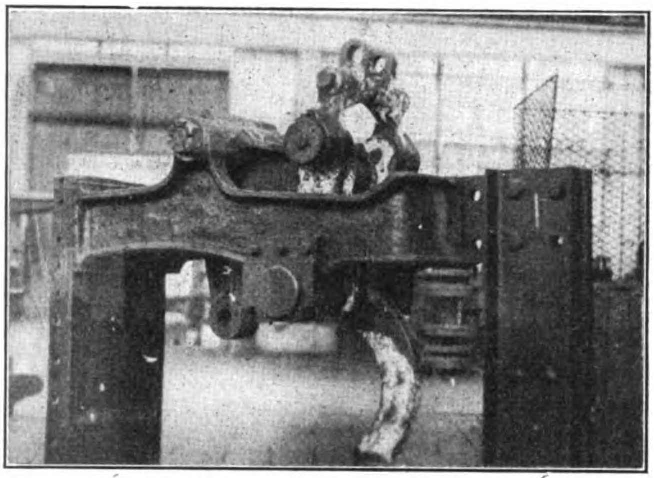
It has been claimed that the first locomotive laid out in this manner made about 30,000 miles with very little flange wear. The riding qualities of the engine are reported as being excellent.

Assembling Baker valve gear

By J. H. Hahn

Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

THE accompanying illustration shows a frame for assembling the bell crank, reversing yoke, radius bars and gear connecting rods of the Baker valve gear to test the alinement of these parts and to see that all parts are properly fitted up before sending them to the erecting shop. This frame is made of a standard gear



This device is made of a standard gear frame for the Baker valve gear

frame for the Baker valve gear which is supported on legs made of 12 in. channel iron or other suitable material.

The bosses that the lower ends of the radius bars fit in have been machined off flush with the face of the gear frame, and vee blocks have been bolted on in their place as shown in the illustration. Studs with keyways in the lower ends instead of threads are used to hold the caps on the vee blocks. The radius bars are placed in position in the gear frame and the caps placed over the studs and then tapered keys are driven in to hold the caps.

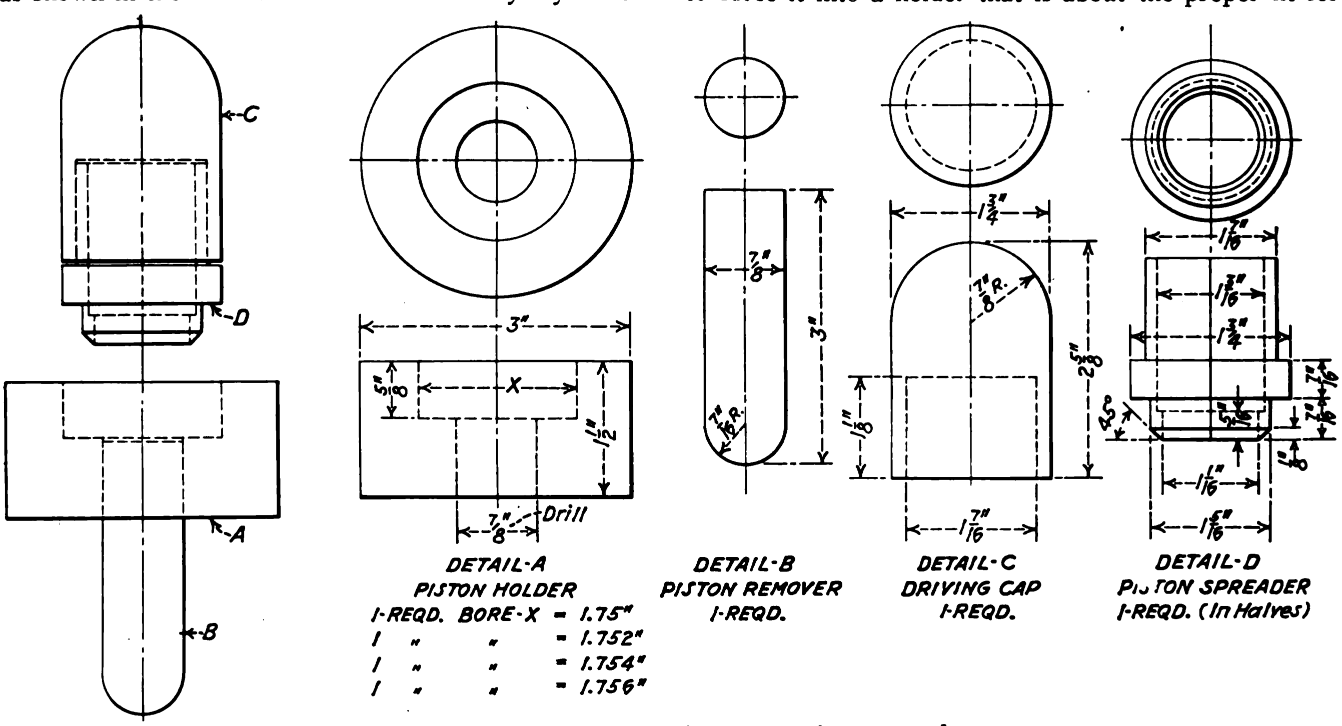
Feed valve piston spreader

By H. J. Duernberger

A PRESSURE feed valve piston does not contain piston rings and when worn, either must be spread to fit the bushing or be thrown away. The majority of the feed valve piston spreaders now in use upset only one or both edges of the piston which soon wears off and leaves the piston too loose to give the proper leakage fit. The sharp edges quickly ruin the bushings.

The accompanying illustration shows a tool designed to spread as wide a surface of the piston as possible so as to save the bushing and also to have the piston fit last much longer. The best way to use the tool is to have the four piston holders, detail *A*, arranged in a row in a solid, heavy piece of metal at the rear of the work bench or test rack, close to where the feed-valve is bolted on the test bracket. These holders increase in size from 1.75 in., which is the standard size of the feed valve piston, to 1.756 in. by increments of .002 in. Where other than standard sizes of pistons are used it is advisable to make piston holders to fit each size. These should be made in steps of .002 in. larger in size than required for the standard size of pistons. When a feed valve is found that has a piston too loose to give the proper leakage, the piston and supply valve is removed as a unit. Detail *D*, which is in two parts, is slipped over the slide valve and into the groove on the piston. The driving cap *C* is slipped over the spreader and then the piston is tried in the four holders to determine the one which fits it the closest. When the piston is in the proper holder, hit the driving cap a light tap and then try the piston in the feed valve, and if still too loose, spread it further until the right fit is obtained. If the piston sticks in the holder, drive it out with the piston remover.

If the piston is worn out of round, it is good practice to force it into a holder that is about the proper fit for



Details of the Duernberger feed valve piston spreader

the piston and then drive it down solid into the holder which will throw the metal out on the worn spots to the fit of the holder. A great many times the rounding of the piston will be sufficient to give the proper leakage fit.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Grease for lubricating trailer truck journals

PERU, Ind.

TO THE EDITOR:

Since reading the editorial on "What about trailer truck lubrication?" which was published on page 77 in the February issue of the *Railway Mechanical Engineer,* I have been turning over in my mind the special emphasis laid on the lubrication of engine truck and trailers on locomotives used for long runs of 500 to 800 miles. This is one subject that has been neglected for a number of years, in fact one might make it a little stronger and say for ages, as the present system of lubrication is practically the same as it was when Joseph Rogers and Mathias Baldwin commenced building locomotives in America, which was in 1831 and 1835, respectively. We have depended on the action of the capillary attraction of wool waste to raise oil from the cellar to the journal. This is very good, but on long runs such as we have today this waste will settle or become so compact that the capillary attraction feature is, in a sense, destroyed. This is one thing that the mechanical department of railroads will have to take into consideration, on long locomotive runs.

The functioning of the waste-packed cellar is impaired on these long runs, to the extent that the proper lubrication of journals is unreliable and a substitute for oil must be found. Grease applied under slight, but constant pressure, is the remedy, something that will not be affected by long runs under various climatic conditions. It is not the amount of lubrication that is used on a journal bearing, but the fact that it is ever present and the journal is not allowed to run dry until heating starts, when oil lubrication becomes ineffective.

J. E. ALLEN.

The hot box problem—what about anti-friction bearings?

HAMMOND, Ind.

TO THE EDITOR:

A popular subject for discussion among various railroad clubs at the present time which has been a favorite subject in the years gone by is our old pal the Hot Box. The lubricating engineer of the A. B. C. railway reads a paper before the Podunk Carmen's Club. The paper is a good one and is thoroughly discussed. The author of the paper is given a rising vote of thanks and the members of the Podunk Carmen's Club "gird their loins" and go forth to do battle with their common enemy.

The expert in charge of lubrication on the X. Y. Z. railroad prepares and reads a paper before the Big Town Railway Club. Subject: "Hot boxes, their prevention and cure." He is given a vote of thanks, etc. Some of these papers are really well prepared and probably are understood by most of the club members. Others are technical, very technical indeed. It is doubtful sometimes if an occasional paper is understood even by the gentleman who prepared it.

In their efforts to find a method of overcoming the friction between the journal and bearing, so many gages to measure the bearings, keys, journals, boxes and dust guards have been designed that the journal box attendant would need considerable assistance if he tried to use them all. One expert says "don't do this," another says "don't do that," and after all is said and done they are only hoping for a reduction in delays caused by hot boxes. But, to paraphrase the song, "The little hot box on the railroad keeps burning the mileage away."

For many years no change has been made in the method used in affording lubrication to car journals. In a comparatively short time the capacity of the car has been doubled. The cry for speed and more speed is unceasing. The more weight and speed means more friction which in turn means more hot boxes.

This may be treason, but the writer wonders if the time isn't near when the old brass and packing method of the present will have to give may to modern roller or ball bearings? The initial cost would be high, but after viewing results in the motor industry, it might be the cheapest in the end.

H. R. RICE.

Cooling surface in the boiler furnace

PHILADELPHIA, Pa.

TO THE EDITOR:

In your May, 1926, issue, C. A. Seley takes exception to certain statements of mine published in the April issue, page 212, under the title, "Future Possibilities of the Locomotive Boiler." In so doing he introduces the subject of radiant vs. convection heat absorption, which has been agitating the engineering world this past year.

It seems agreed among stationary plant engineers that some water cooling surface in the boiler furnace promotes efficiency. They are still not agreed, however, despite Professor Christie's statements, on the limit to which such water cooling should extend. Thus Broido, one of the more recent writers on the subject, states in *Mechanical Engineering*, February, 1926, "The amount of water cooling surface that can be installed without lowering the furnace temperature to a point where combustion will be affected is dependent on the kind of coal used. Enough refractory, in other words firebrick, must be in the furnace, however, to reflect sufficient heat so that the temperature of the gases throughout the furnace is not lower than that required for combustion."

It must be remembered that stationary furnaces generally have greater combustion volumes than locomotive fireboxes, so that the water cooling surface has relatively less effect on the completion of combustion. It is not surprising then that stationary plant engineers should be

turning to the partial water cooling of their furnaces, who up till now have permitted so little of it.

After all is said and done, heat not absorbed by radiation in the firebox is not lost. It only increases the temperature of the firebox gases, thus aiding combustion. Increasing the temperature of the gases on entry to the tubes does not markedly increase the smokebox losses, since the tube evaporative efficiency per unit increases. Thus applying the formulas of Lawford Fry, it can be shown that gases entering a 20-ft. tube at 2,400 and 2,000 deg. respectively will show at the smokebox end but 25 deg. difference in temperature. It is thus evident that the amount of heat transfer in the firebox means comparatively little. Widely varying types of boilers show little real difference in their efficiency of heat transmission.

There are three kinds of efficiencies by which a boiler may be measured:

1—Efficiency of combustion.
2—Efficiency of heat transmission.
3—Efficiency of heat utilization.

The second or efficiency of heat transmission, is the type mentioned above.

The efficiency of combustion shows much chance for improvement. Nowadays locomotive boilers are designed to give their rated tractive force at 120 lb. of coal per sq. ft. of grate area per hour. Yet the actual heat utilized in evaporation is only about 55 per cent of the coal fired at such rates of burning, even though the heat transmission efficiencies be 75 or 80 per cent. This is due to the high unburnt fuel loss, averaging 25 per cent of all the coal fired at the 120-lb. firing rate, most of which goes up the stack as unburnt carbon or gathers as front end cinders and the like. It is evident then that the present type of locomotive and firebox is not keeping pace with the demands made on it.

The efficiency of utilization is another way of stating the ability to realize more mechanical work from the heat actually absorbed by the boiler. This finds its vehicle in the use of higher pressures, which are gaining more and more recognition from the engineering world every year. In two warships contemplated by the Government the use of 700 lb. pressure is being seriously considered, because of its possibilities in the saving of weight.

Sooner or later the writer feels that the staybolted locomotive firebox will have to go, and probably the firetube barrel as well, as neither is as well adapted as the watertube boiler to the higher pressures and improvements in combustion efficiency that the future is likely to demand.

We agree with Mr. Seley that the future locomotive will still be steam propelled in the majority of cases. There are some 260,000 miles of track and 60,000 locomotives in the United States today, a ratio of four to one. This ratio may decrease with time, but the building of branch lines in unsettled territory will tend to maintain it. It is inconceivable to think that financiers will go to the trouble of electrifying four miles of line for the debatable economies to be obtained from the electrifying of one locomotive. Heavily traveled routes, of course, may be electrified.

The Diesel engine's first cost is against its adoption now, and by the time this is reduced American oil supplies will be scarcer and oil more expensive than at present.

On the other hand we do not believe that the steam locomotive is going to stand still. It is not efficient now at rates of firing becoming common, nor do we feel that 200 lb. pressure is the last word of the next generation.

L. A. Rehfuss.

How far should engines be stripped?

Prescott, Arizona.

To the editor:

Your editorial in the August, 1926, *Railway Mechanical Engineer* on engine stripping, opens quite an interesting subject. Our experience with modern power when operated under an approved system of maintenance is that the extent to which engines should be stripped for general repairs should be governed entirely by conditions rather than by following any hard and fast rule. The determining conditions should be the age of the locomotive and the maintenance attention given it while in service.

When a locomotive needs general repairs it should certainly get all that the term implies and be turned out in condition to render any service it was ever capable of performing. It is a fact, however, that comparatively few locomotives shopped for general repairs need that thorough and minute inspection, necessitating a stripping to the ground which the term "general repairs" may be taken to mean.

Under a proper system of maintenance it is not practicable to run a locomotive until all the parts are worn so that general repairs of that character are required. The observance of federal rules as to limits of wear on machinery parts, boiler conditions and the life of flues, etc., has long ago corrected that practice where it was in effect. The reasonable requirements of service and economy of operation make it necessary to maintain certain vital parts of the locomotive in good condition at all times. Such maintenance work is strictly enginehouse or light repair work and the enginehouses are in position to keep them in as good condition as the back shop and should do so. If, for example, new bull rings and cylinder packing have recently been applied, piston rods turned, crossheads and guides alined, why should the back shop take on the expense of stripping these parts again if the engine is shopped for general repairs? It is questionable indeed if there is any economy in running locomotives until they need general repairs involving stripping them to the ground.

Modern heavy power used to its maximum making say, 12,000 miles per month in passenger service and 8,000 miles in freight service, develops conditions on tires, driving boxes, rods and other related foundation parts that require unwheeling every four to six months to keep them in first class condition. This can be done in from four to six days in a modern shop and by repeating that work and properly maintaining the lighter repairs and inspections in enginehouses, general repairs involving stripping off of all parts would be considered under three conditions only; namely, when engines have been wrecked; when they are getting old and approaching limits of wear or giving evidence of deterioration of material; or when held for heavy firebox or boiler work when the out of service time should be taken advantage of to inspect thoroughly and recondition all parts.

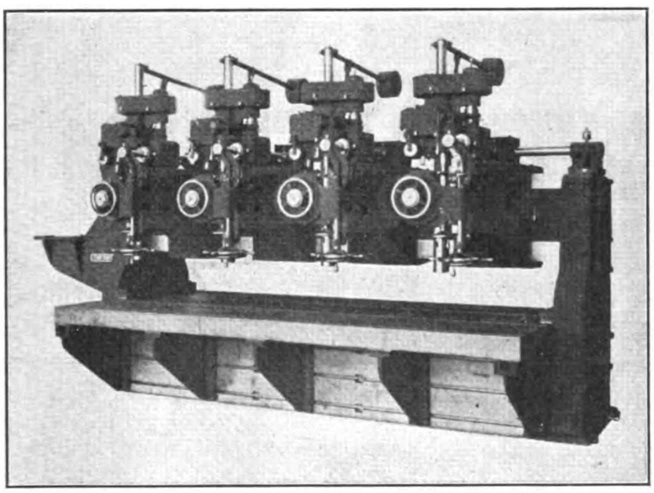
Charles Raitt,
Assistant master mechanic, Atchison, Topeka & Santa Fe.

Accident prevention.—"Accident Prevention on a Railroad" is the title of a booklet issued by the Metropolitan Life Insurance Company, 1 Madison avenue, New York. The report in this booklet contains the story of an accident-prevention survey carried out by the safety engineers of the Policyholders' Service Bureau for a Class I railroad—a group insurance policyholder of the Metropolitan Life Insurance Company. It illustrates the method used in making such a study and the type of information deemed essential.

Mud ring and flue sheet drilling machine

To meet the demand of the railroad shops for heavier equipment required in the building of the modern type locomotive, the Foote-Burt Company, Cleveland, Ohio, has recently designed a drilling machine, which is called the No. 3 mud ring and flue sheet drilling machine, regularly equipped with four No. 30 heads. The long travel of the table, the back and forth, as well as the in and out adjustment of the spindles, allows the drilling of large flue sheets in one setting.

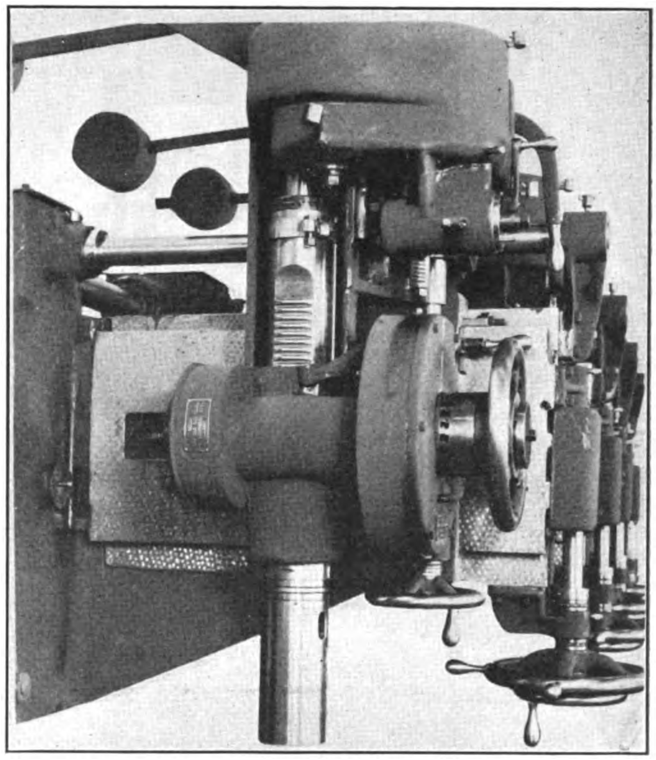
The spindles overhang the finished edge of the base so that mud rings can be bolted to this finished edge by means of three T slots running horizontally, for drilling the rivet holes. The two further outside knees that support the table are fixed, but the three center knees are adjustable in case they interfere with the clamping of mud rings. When drilling flue sheets all knees are securely doweled in position to form the bearing for the table.



The Foote-Burt No. 3 mud ring and flue sheet drilling machine

This machine is so arranged that a pit can be placed in the floor flush with the front finished edge of the base to allow the mud rings to project down in it for drilling the rivet holes. The size of the pit is governed by the size of the mud ring.

The machine can be arranged for either belt or motor drive. The power is transmitted through a heavy horizontal shaft where the drive is taken for each head, through bevel gears. From there power is transmitted through a vertical shaft in each head through spur gears direct to the spindle. All gears subject to heavy duty are made of high grade steel and all shafts are mounted on bronze bearings.



The head and spindle are of massive construction

Each head has a drilling capacity of 3½ in. in solid steel, or 7 in. using a flycutter. Each head is adjustable along the rail, the minimum center distance between the spindles being 24 in.; the maximum distance between the two outside spindles is 123 in. The spindles also have an in and out adjustment of 18 in. All hand wheels controlling the adjustments of the heads are located at the

front of the machine within easy reach of the operator. This also includes the hand wheel which controls the spindle itself. Each head is equipped with three quick feed changes independent of each other. The speed changes are accomplished by the cone pulley and back gears when the machine is arranged for belt drive, or by a variable speed motor when arranged for motor drive. The speeds in each head cannot be changed independently.

The spindles are made of high carbon steel and have long bronze bearings in the spindle sleeve. The spindle sleeve is also made of steel. The double rack is cut from the solid. This double rack feature is a "Foote-Burt" patent, and is said approximately to double the strength of the down pressure, which is enormous when large sized drills are used.

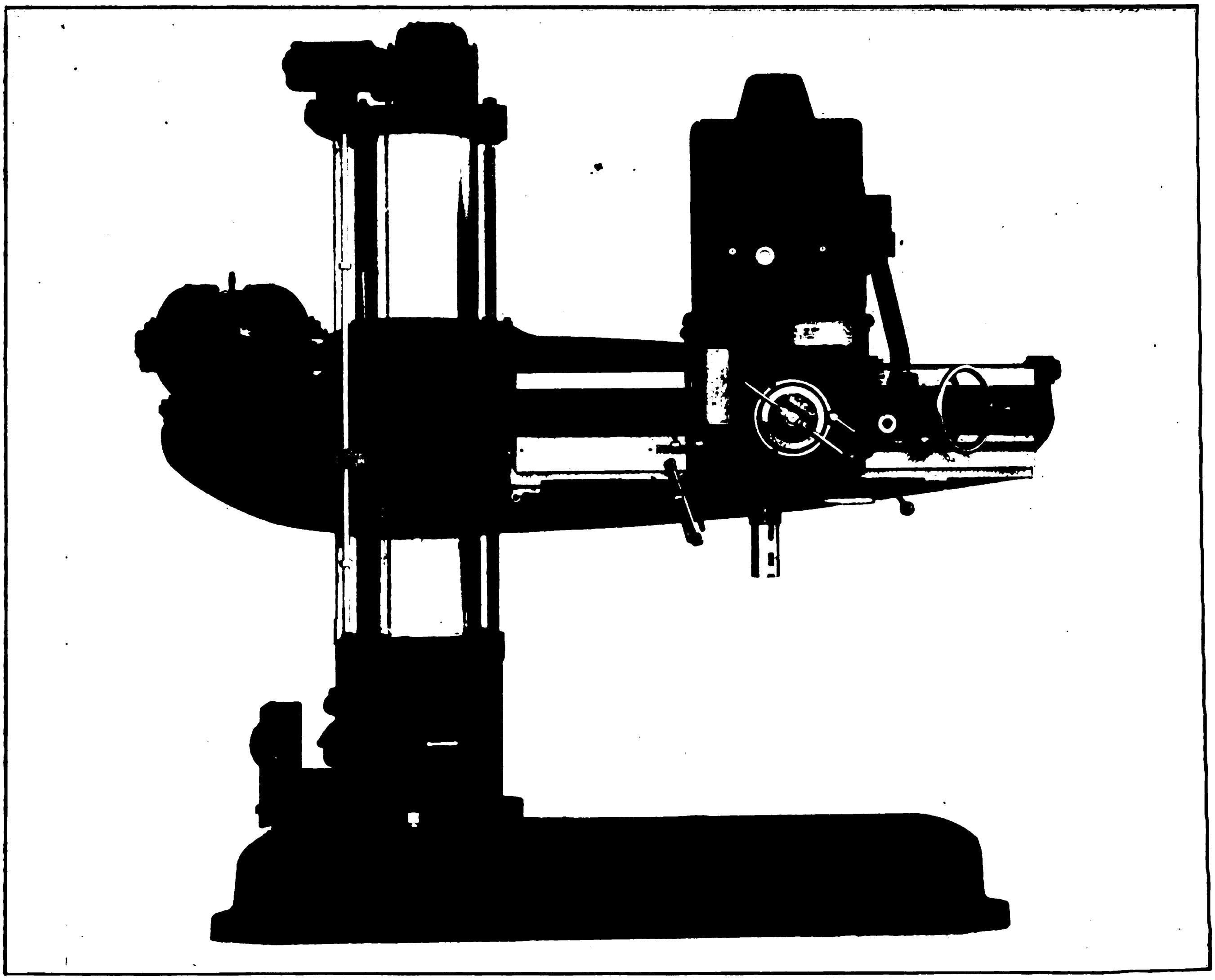
Great care has been taken in the design of this machine to make it as rigid as possible, the uprights being securely bolted to the base in an L-shaped pad. The cross rail carrying the heads is a box type and is placed in large slots in each of the uprights and securely bolted from three directions. Each head slide is wrapped completely around this box type cross rail and securely gibbed to obtain the maximum of bearing on the rail.

The table has a working surface of 75 in. by 144 in., and is provided with an in and out adjustment of 60 in. It should be placed at the extreme rear position when drilling mud rings.

The Cincinnati Bickford new radial drill

THE Cincinnati Bickford Tool Company, Cincinnati, Ohio, has just placed on the market an entirely new design of radial drill known as the Super Service drill. In the development of this machine, which is built in 5-ft. and 6-ft. sizes, the aim of the builders has been to speed up drilling time by reducing handling time. To accomplish this the design incorporates a 36-speed, 18-feed head in which all speeds are in the head; power rapid traverse; an easy swinging arm readily moved by the slight pressure of one hand; single lever arm control; power column clamping, either electric or pneumatic; and finally, all controls centralized so as to be accessible to the operator without moving away from his work.

In an effort to reduce maintenance to a minimum and insure long service the machine is built with Timken tapered roller bearings, automatic lubrication with Purolator oil filter system, multiple splined shafts with inte-

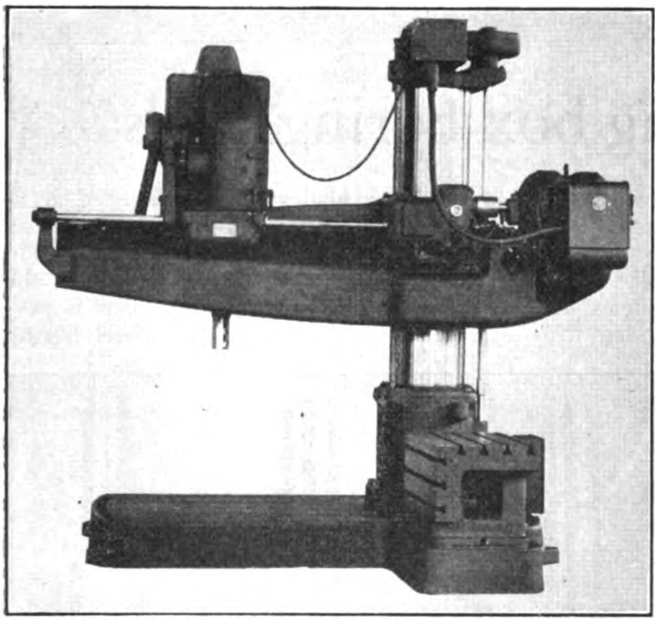


Front view of the 5-ft. super service radial drill, showing the arrangement of the controls

gral keys, all speeds and feeds through selective sliding gears, driving and feed change gears of heat treated alloy steel and square guideway mounting of the head on the arm. Safety features have been provided by the use of a patented safety nut to sustain the arm should the main elevating nut fail, a positive interlock to prevent elevation of the arm when clamped, a safety catch which prevents the spindle from dropping should the counterbalance chain break and the placing of the counterbalance inside the head.

The base is of box section throughout. Its entire area bears on the surface of the foundation. The top and bottom of the base are tied together by a system of heavy longitudinal and transverse ribs. These ribs, which are closely spaced, uniformly support the top of the base so that jack screws or other auxiliary supporting devices are not required. The weight of the column, arm and head, together with the work, is transmitted directly through these ribs to the foundation.

The column diameter is 17 in. The flange is double thickness and the clamping surface has a large contact area. The construction of the lower part of the column, which permits of easy swinging of the arm, is distinctive. It consists of four large diameter, hardened steel rollers mounted on roller bearings. These rollers are built into the sleeve above the clamping surface and roll on a hardened and ground steel ring on the trunk.



Rear view of the new radial drill, showing the oil pump and Purolator—The air and electrical connections are carried up through the columns

Power column clamping, either air or electrically operated, is standard equipment. It enables the operator to clamp and unclamp the column without leaving his operating position at the head. This feature eliminates two round trips from the head to the column for every hole drilled. Air clamping is obtained through a double-acting air cylinder housed in the driving motor support. Electric clamping is obtained through a torque motor mounted on top of the column. Both the air cylinder and the motor are so located that they are not exposed to dirt and chips, nor are they in the operator's way. The hand clamping lever does not move when power clamping is employed.

The arm is massive, yet swings under the slight pressure of one hand. It is of patented, triple box section. The front and rear walls are tied together with heavy longitudinal ribs. All openings in the rear wall have been completely eliminated. The depth of the arm and the length of bearing on the column have been increased. A system of square lock gibs has replaced the dovetail mounting of the head on the arm. This provides a bearing which assures alignment in service. It prevents the rocking tendency of the head due to lack of adjustment of the main gib or the cutting action of the tool.

The entire raising and lowering mechanism is built into the arm as a complete unit, fully enclosed and automatically oiled by a system of flood lubrication. The old style rising and lowering mechanism on top of the column with its clash gears has been discarded. The screw is held stationary—the nut revolves. Friction clutches incorporated in the unit drive the nut in either direction. A patented safety nut sustains the arm and prevents it from dropping should any failure occur in the threads of the main nut. The safety nut gives immediate warning of the failure and the worn nut must be replaced before any further raising or lowering of the arm is possible.

A single lever clamps, unclamps, raises and lowers the arm. An equalized screw and lever action, applied at both ends of the arm cylinder, binds the arm tightly to the column. Greater leverage is provided for closing the upper end on account of the increased resistance at that point. A positive mechanical interlock prevents any engagement of the raising and lowering mechanism while the arm is clamped to the column. Safety stops prevent any movement beyond the upper and lower limits of travel.

Only one motor is required to drive the spindle, elevate the arm and operate the power rapid traverse. This motor is of the constant speed type for either direct or alternating current. Variable speed or multi-speed motors with their complicated control systems are not necessary. The motor support is of deep section and cast integral with the arm. The machine is completely wired. The wiring is run from the motor to the top of the column, down through the inside, and brought out through the rear of the base for connecting with an outlet in the floor. Piping for the air type column clamp is handled in a similar manner. Both have revolving connections in the lower part of the column which allow the arm to swing in a complete circle.

Thirty-six speeds and 18 feeds are incorporated in the head. The head is completely enclosed, includes power rapid traverse and contains the entire speed change mechanism. The entire driving mechanism—from motor to spindle nose—revolves in tapered roller bearings. They are completely sealed against the entrance of dirt and are automatically oiled. All shafts are multiple splined with integral keys. All driving gears and feed change gears are of carefully selected heat treated steels. All feed and speed change gears are of the selective sliding type. Tumbler gears and dive keys have been discontinued.

Power rapid traverse to the head is standard equipment. The constant speed arm shaft has been utilized as a source of power which reduces the rapid traverse to a relatively simple mechanical device. The head moving handwheel does not revolve when the power rapid traverse is engaged.

All of the 36 speed changes are in the head. They are obtainable through selective, sliding gears by the use of only three levers. They have a 60 to 1 range with a maximum of 1,415 r.p.m. They are closely enough graded that a speed can be selected which will drive a drill up to the limit of its working capacity.

The machine can be furnished with any one of five intake speeds which provide the following minimum and maximum spindle speeds—15 and 912, 16 and 1,004, 18 and 1,124, 21 and 1,278, 23 and 1,415 r.p.m.

Eighteen feed changes are obtained through selective, sliding gears by the use of only two levers. The feeds range from .006 in. to .125 in. per revolution of the spindle and include tap leads for 8, 11½ and 14-thread pipe taps. The tap leads relieve the operator of the exertion required to start pipe taps and eliminate the possibility of thin threads. A compensating depth gage not only drills to a prescribed depth but also compensates for the length of the drill point. This feature assures for accuracy.

The spindle has six splines insuring minimum feeding resitance under heavy torsional loads. This is of extreme importance on heavy tapping for it eliminates the danger of thin threads. The spindle sleeve and feed rack pinion are of special alloy steel having an ultimate tensile strength of more than 200,000 lb. per sq. in. The feed rack is integral with the spindle sleeve. The spindle revolves in roller bearings packed in grease which eliminates indifferent spindle oiling and the resultant damage to bearings.

The spindle is counterbalanced at all positions by a flat, coiled spring of unusual capacity. A patented cam arrangement compensates for the varying tension of the spring. The tension can be quickly adjusted to provide additional counterbalancing for heavy cutter bars, etc. A patented safety grip prevents the spindle from dropping should the counterbalance chain break. The entire counterbalance mechanism is enclosed in the head.

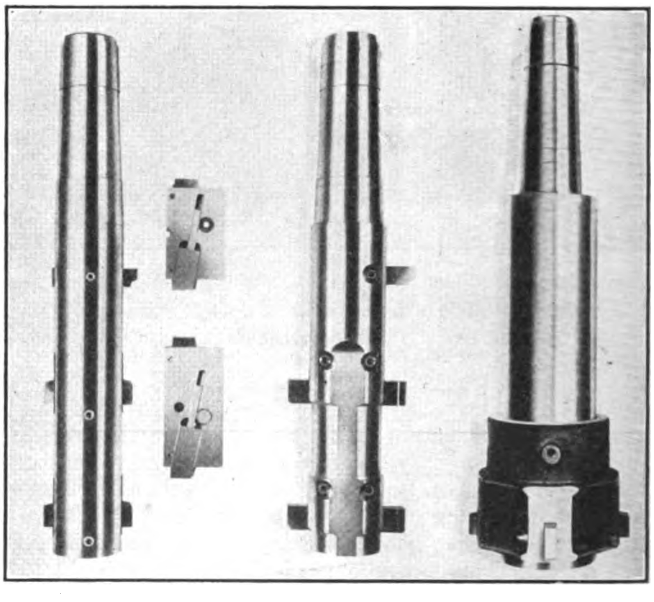
Lubrication has been so designed that the machine operates over a long period without oiling. The entire head is automatically oiled. A submerged pump forces oil through a Purolater filter to the top of the head where it cascades down through all gears and bearings. The friction clutches run in oil. A high pressure grease system lubricates the roller bearing spindle. A large reservoir with wicks and copper tubing oils the gibs and all surfaces of the head which bear on the arm. The arm raising and lowering unit and the motor driving gears run in oil. The arm shaft outer bearing is packed in grease.

Car wheel and driving box boring tools

THE Kelly Reamer Company, Cleveland, Ohio, has placed on the market several types of recently developed tools particularly adapted to car wheel and driving box boring work. In the design of these tools the manufacturer has recognized the fact that railroad shop work is not primarily of the large production nature and that it is necessary to accomodate tools to the handling of a large number of miscellaneous sizes. In addition to this, these new tools have been designed with the idea of simplifying the process of changing tools for different sizes of work. The illustration shows three types of boring tools—two of which are especially adapted to boring car wheels and the third for driving box work. Of the two car wheel boring bars one is of the expansion type and the other a special design using block unit tools. By the use of the block unit tools it is possible to bore a complete range of sizes with one bar and the different block units making it possible to effect a considerable saving of time by eliminating the necessity of changing and realining the complete bar.

As may be seen from the illustration, the support bar may be set up, alined and keyed in position. It is not necessary to remove the bar from the machine because of the fact that it accommodates several sizes of block units which can be quickly interchanged in the bar for different size bores. When the larger sizes are encountered a support head is slipped on the bar which supports the block unit close to the cutting points, giving added strength to the tool without the inconvenience and loss of time occasioned by changing the bar in the machine. This latter type of tool is particularly adapted to the boring of driving boxes and side rods.

The construction of the block unit is particularly heavy to withstand the shocks to which they will be subjected. The blades are made of special analysis high speed steel of heavy cross section so as to present ample cutting face and to dissipate readily the heat of heavy cuts. Adjustment of the blades is secured in or out by means of a rack which engages a pinion. This pinion is integral with a worm wheel which engages the worm. As the worm wheels of both blades are driven by the same worm, both blades can be adjusted accurately in or out simultaneously. This construction has been used with the idea of preventing any change in blade adjustment due to the thrust action upon the blades. In addition to this, however, each blade is provided with an individual lock. The car wheel boring

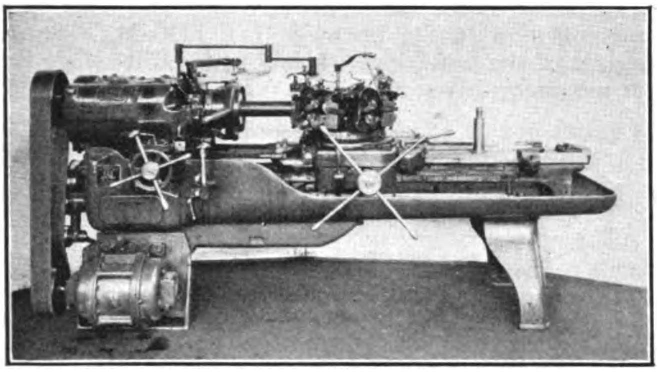


Beginning at the left bar No. 1 shows the block unit car-wheel boring tool—Bar No. 2 represents the expansion car wheel boring tool—Bar No. 3 shows the driving box boring tool assembled with the support head and block type cutter in place

tools are designed to handle a range of bores from 5½ in. through and including 9 in. The side rod boring tool is designed to handle bores from 5½ in. through 11½ in. and with the use of the support head from 11¼ in. through 14 in. The driving box boring tool will handle with the open bar, bores from 8 in. through 11½ in., and with the support head from 11½ in. through 14 in.

Hartness 4-in. by 34-in. flat turret lathes

A 4-IN. BY 34-IN. Hartness flat turret lathe, made both as a bar machine and as a chucking lathe has recently been placed on the market by the Jones & Lamson Machine Company, Springfield, Vt. The capacity of the machine for bar work is 4 in. in

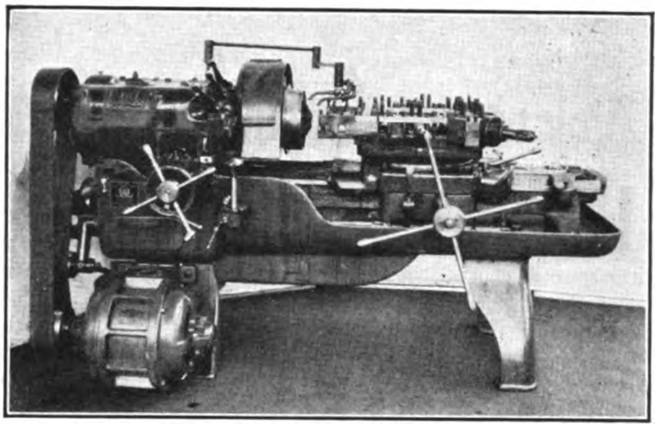


The Hartness bar turret lathe

diameter by 34 in. in length. The chucking lathe is equipped with a 17-in. chuck and has a swing of 21 in. on centers and a swing over the ways of 17½ in.

The headstock has been redesigned, not only to add to the spindle capacity, but also to the rigidity and pulling power of the lathe. The spindle is 5¼ in. in diameter with a hole $4\frac{3}{16}$ in. in diameter. It is mounted in large split bronze bearings. The shafts are made of heat treated alloy steel and mounted in ball bearings. The change speeds, forward and reverse, are effected through multiple disc clutches. These clutches, shafts and gears are sufficient in strength to pull any work within the capacity of the machine and to insure the positiveness of rotation equal to the cuts in the 17-in. chucking lathe.

The bar outfit is similar to that of other Jones & Lamson flat turret lathes. The 17-in. chucking lathe is equipped with a square turret. Simple multiple tooling on large diameter chuck work is made possible by the large square turret and the cross sliding headstock. The

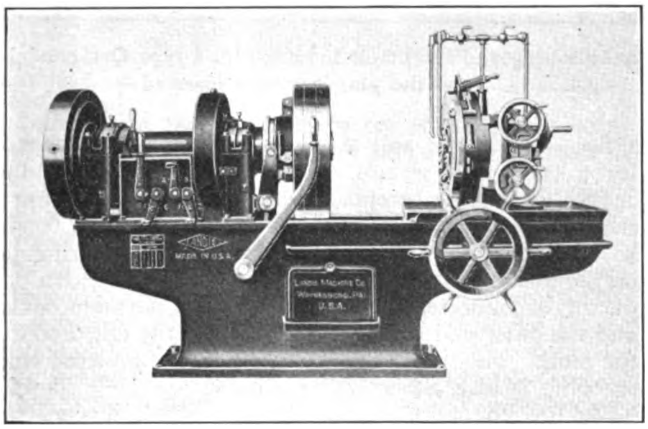


The Hartness motor driven 4 in. by 32 in. flat turret chucking lathe set up to machine a piston valve head

tooling of the 17-in. chucking machine is also similar to the tooling of the other Jones & Lamson chucking machines. The inexpensive standard tooling is sufficient for the majority of chucking work and special tools are seldom required.

Four-inch pipe threader and cutter

THE Landis Machine Company, Waynesboro, Pa., has added to its line of pipe threading and cutting-off machines a 4 in. size which has a base of different design from the other sizes. The new out-

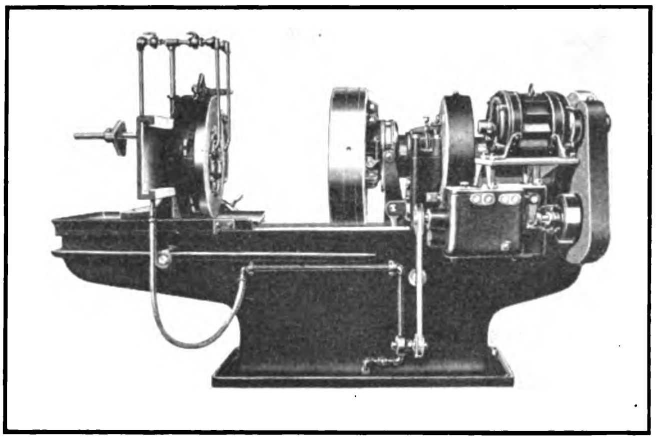


The operating levers are conveniently located

line of the bed offers ample support for the headstock and carriage.

The machine has a gear box and a single pulley drive, and is readily converted to motor drive. All gears are cut from steel and run in an oil bath. A reversing mechanism contained in the gear box is operated by a lever. This reversing mechanism eliminates the necessity of crossing the belt or throwing a switch when the machine is to be reversed.

The front and rear chucks are of the three-jaw type.



Rear view of the Landis 4-in. pipe threading and cutting off machine showing the location of the gear box and motor

The front chuck, which has a universal adjustment is lever operated, thereby permitting the pipe to be put in and taken out of the machine without stopping. The

rear chuck has an independent adjustment. The main spindle of the machine is supported by two distinct bearings which are lubricated by flat link chains running in an oil reservoir.

The carriage supports the cross rail, on which is located the die heads, the centering jaws, the cutting off tools and the reaming tool. Two cutting off tools are employed and are located diametrically opposite each other in holders which have a universal movement to and from the center. These holders also have a horizontal adjustment for centering the tools. The reaming device is attached to the cutting-off tool slide and is lever operated.

The range of the machine is from 1 in. to 4 in. This range is covered by two Landis stationary pipe die heads, namely a 2 in. head for a range from 1 in to 2 in. and a 4 in. head for a range from 2½ in. to 4 in. The die heads float in a T-slide on the cross rail.

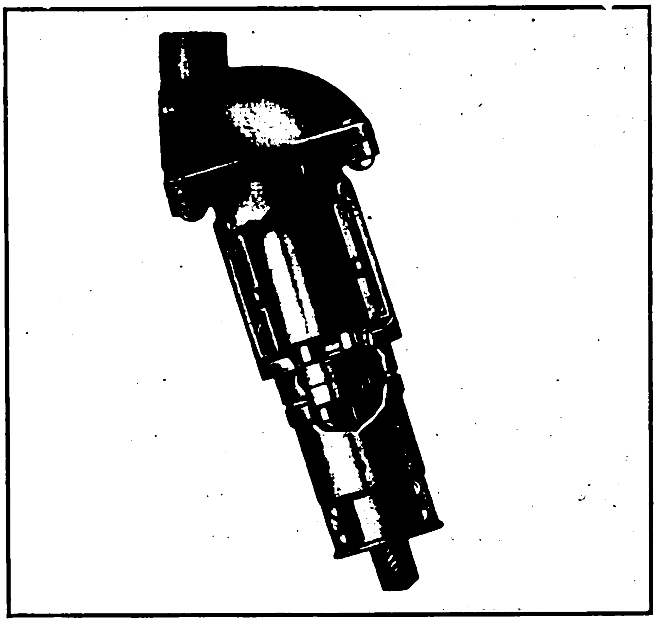
All starting, stopping and reversing levers are located on the operating side of the machine within convenient reach of the operator, as are also the levers for obtaining the various speeds. The machine has eight speeds. The travel of the carriage is 24 in. The floor space required is 4 ft. 5¼ in. by 8 ft. 6 1/16 in. The net weight of the belt-driven machine is 5,700 lb. while that of the motor-driven machine is 6,300 lb.

Arktite circuit-breaking plugs and receptacles

PLUGS and receptacles embodying a principle which meets the demand for circuit-breaking devices in capacities heretofore considered impractical are being manufactured by the Crouse-Hinds Company, Syracuse, N. Y.

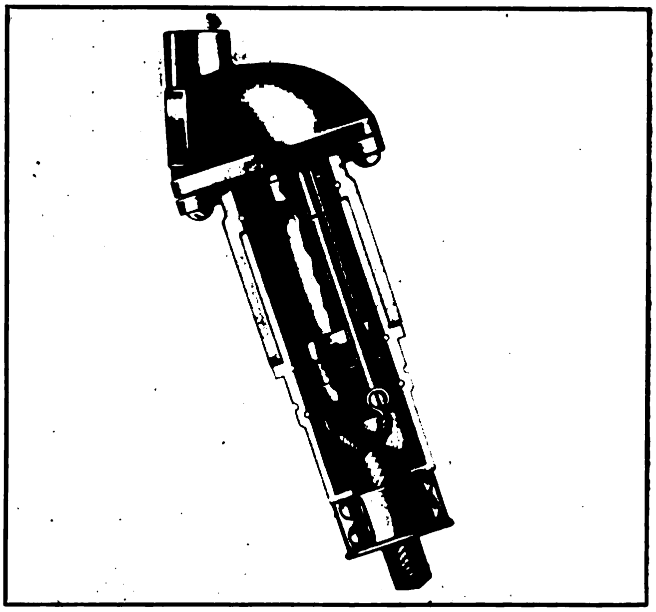
As the name implies, the arc formed by pulling the plug is so completely confined in a chamber of insulating material that it is impossible to form a short circuit or ground. The air and gases confined in the chamber expand rapidly and smother the arc.

Portable devices can be thoroughly grounded through Arktite plugs and receptacles. Where it is permitted to use a ground wire having a current capacity less than that of the circuit wires, the cable connected to the plug must have an extra conductor for grounding, and one end of the extra conductor must be connected to the frame of the portable device. The other end of this extra conductor is bent back, threaded through a slot and connected to a grounding screw on the outside of the plug handle. The ground connection is completed through the detent springs in the receptacle, when the plug is inserted. This method conforms to the requirements of the National Electrical Code.



Arktite plug and receptacle mounted on a type Qee condulet, showing the detent spring

Where it is required to use a ground wire having a current capacity equal to that of the circuit wires. The cable connected to the plug must have an extra conductor for grounding and the plug and receptacle must have an extra pole to which the grounding conductor is connected. Therefore, where it is desired to ground the frame of a portable device in this manner, it will be necessary to use a three-pole plug and a receptacle for a two-wire circuit and a four-pole plug and receptacle for a three-wire circuit. To complete the grounding connection on the receptacle, either a grounding ring is clamped between the receptacle housing and the condulet, or a flexible cable is connected to the soldering lug on the inside of the condulet. One end of the extra conductor is connected to the frame of the portable device, and the other end must be connected to the extra pole in the plug. The grounding connection is completed when the plug is inserted in the receptacle.



Arktite plug and receptacle mounted on a type Qee condulet, with the plug partially inserted

Arktite plugs and receptacles are simple in construction. The contact members in the receptacle are fingers and those in the plugs are tubes, each of a single piece of special alloy brass machined to an accurate fit. The receptacle fingers are slotted and opened slightly to insure a good contact. The plug tubes fit very closely into chambers of insulating material in the receptacle when the plug is inserted, and the circuit wires are connected directly to the ends of the contact members, eliminating

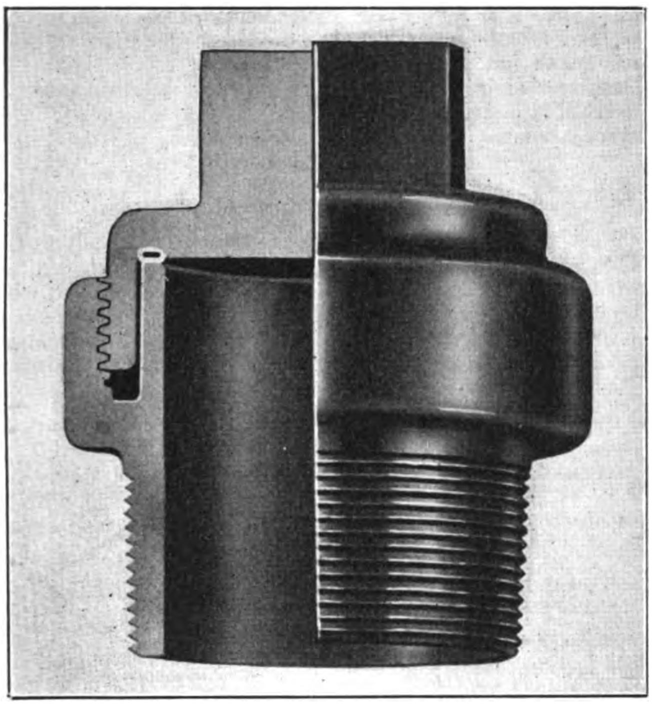
all lugs. The insulating parts of both the plug and receptacle contain separate chambers for each pole, in which the arcs are broken.

No screws are used in assembling the interior parts of the plug and receptacle. All parts are held in position by phosphor bronze retaining rings, which seat in grooves and cannot be dislodged by vibration or strain. To wire the plug the phosphor bronze retaining ring is removed by inserting a screw driver a quarter turn. The retaining ring will then spring out of its groove, and can readily be removed, permitting the withdrawal of the interior parts. The receptacle is wired in a similar manner.

These plugs and receptacles are made in 10, 30, 60, 100 and 200 amperes; 250 volts a. c. or d. c., 600 volts a. c.; and two, three and four poles.

Safety washout plugs with Acme threads

The Housley Flue Connection Corporation, Indianapolis, Ind., has recently placed a safety type of washout and arch tube plugs on the market which represent a distinct departure from conventional design. The fundamental idea of the Housley plug is to provide a safe arrangement whereby the threads in the boiler sheets are protected from injury and at the same time allow better inspection and more thorough cleaning during the washout operation. This idea has been put into practice by making the plug in two parts—one part remaining permanently in the boiler sheet and the entire unit being made of forged steel.



When no threads are visible on the cap of this plug it is an indication that the cap is properly seated on the gasket

The details of construction are plainly shown in the illustration. The sleeve or body of the plug is threaded with standard boiler threads for fitting into the sheet. The thread by which the cap is joined to the sleeve is known as the Acme thread, the pitch being nine threads per inch. The joint between the sleeve and cap is sealed by means of a graphited copper-asbestos gasket which fits tightly into a cavity in the cap and will not drop out when the cap is unscrewed. The dimensions of the plug and sleeve are such that the cap must be seated to a sufficient depth so that no threads will show, which is an indication that the cap is properly seated on the gasket.

The method of applying the Housley washout plug is simple. The hole in the sheet is reamed and tapped according to the standards of the individual road. The sleeve of the plug is then screwed into the sheet until the fit is steam-tight, after which the inner edge is rolled over the sheet. The cap is then screwed down until the joint between the cap and sleeve is sealed by the copper-asbestos gasket. When the cap is seated, its threads are completely covered by the projecting lip of the sleeve. The sleeve is fastened doubly and permanently steam-tight in the sheet by rolling the thread-fit. The Acme thread connecting cap and sleeve has unusual strength and makes cross-threading of the cap and sleeve impossible. This thread, together with the copper gasket, makes the joint between sleeve and cap secure, yet the cap may be easily tightened or loosened.

Larger holes and clear passages for free washing are other advantages. It will be noted that the holes through which washout nozzles are inserted have no threads so that the washout men can work the nozzles in all directions without the fear that they will damage the threads in the hole. The large openings through the 2⅞-in. plugs on the four corners of the mud-ring and in the barrel of the boiler allow a greater outflow of water which affords a faster and cleaner washout.

Brass flexible pipe joint

Simplicity of construction is the predominant feature of a comparatively new type of flexible joint known as the Flexo which is made by the Flexo Supply Company, St. Louis, Mo. There are no ground parts or springs in the Flexo joints, nor is packing required. A formed, resilient seal is mechanically compressed between two machined surfaces. The pressure of the fluid in passing through the fitting inflates the seal, which with the mechanical compression makes a tight joint at all times, but one that can be easily moved.

These joints are of all-brass construction and their patented design is said to insure a full and uninterrupted flow irrespective of the angle to which the joint is swung. Flexo joints may be used for conveying steam, compressed air, water, oil, or practically any fluid that has no deteriorating effect upon brass. They are furnished in all sizes from ¼-in. to 3 in. with standard female threads.

Engine indicators.—The design and construction of the Maihak engine indicator, its parts and accessories, also the Maihak automatic power integrator, are clearly described and illustrated in Bulletin No. 261 which has been issued by the Bacharach Industrial Equipment Company, 7000 Bennett street, Pittsburgh, Pa. The automatic power integrator is designed to correctly measure mean indicated horsepower over any period of time for any steam engine, regardless of variation of load, and for any oil engine, regardless of any change within the engine cylinder.

PROMOTIONS AND APPOINTMENTS · I.C.C. · THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS · NEW TRADE PUBLICATIONS · NEW SHOPS

The Missouri Pacific and the Denver & Rio Grande Western have consolidated their engine shops and freights yards at Pueblo, Colo.

The Enginemen's School of Instruction on the Wabash will be extended to its subsidiary, the Ann Arbor, in the near future. The school instructs firemen in the economical handling of fuel and enginemen in train handling.

The Pullman Company will add 200,000 sq. ft. of floor space to its Calumet, Ill., repair shops, at a cost of approximately $1,250,000. Plants, office buildings, laundry and oil houses will be enlarged through the construction of several small buildings and additions. Electrical equipment and other machinery will be purchased.

H. E. Byram, receiver, in an address before a meeting of employees of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., on August 23, commended the employees for the response they had made in the last 18 months to the demand for greater economy and increased efficiency. During this period the net tons per train increased from 511 to 680, or approximately 33 per cent, the gross tons per train increased from 1196 to 1523 or 27.3 per cent, and the average load per car from 20.67 tons to 26.35 tons or 22.7 per cent. The consumption of fuel per thousand gross ton miles decreased from 204.2 lb. to 171.6 lb. or 16 per cent.

The Law of New York (known as the Kaufman Act) under which all railroads operating within the limits of New York City are required to discontinue the use of steam locomotives, has been declared unconstitutional in a decision handed down last week by Federal Judges Learned Hand, John C. Knox, and Thomas D. Thacher. The larger roads had already secured an injunction deferring the enforcement of the law. The court holds that the law would be a regulation of interstate commerce, interfering with the proper exercise of such regulation by the federal government. The regulation of locomotives is a field in which Congress has already acted—in the boiler inspection act and in parts of the safety appliance acts.

Musical locomotive whistles on the St. Paul

The Chicago, Milwaukee & St. Paul has had in service for some time on the locomotives of the Southwest Limited, between Chicago and Kansas City, a chime whistle which has proved so satisfactory that it is planned to introduce it for general use. A circular issued by H. E. Byram, receiver, telling of the action of the company in this matter, starts off with verse:

> Casey pulled up that Reno hill
> and tooted for the crossing with an awful shrill.

Continuing, the circular says:

"The immortal Casey Jones, according to the famous song of a decade ago, has 'gone to the Promised Land with his orders in his hand.' But the sudden and lamented departure of that brave engineer did nothing to abate a nuisance that has set millions of teeth on edge and caused the cold shivers to ripple up and down countless spinal columns. Thousands of Casey Jones' compatriots have carried on where he left off and have been 'tooting for the crossing with an awful shrill.' The raucous shriek of locomotive whistles has made night hideous for millions. Needlessly, it seems.

"The Chicago, Milwaukee & St. Paul Railway, after a series of tests, is installing on its engines a new chime whistle which, according to its designer, L. K. Sillcox, is as 'soft as the woodwinds of a symphony orchestra.' It has a baritone mellowness that not even a saxophone can surpass.

"After the new musical whistle was installed on the Southwest Limited, between Chicago and Kansas City, so many communications were received regarding it from passengers and residents along the line that its general use over the C. M. & St. P. system has been approved. Officers of the road are satisfied that the new 'bassoon whistle,' while extremely soft and pleasing to the ear, carries fully as far as the rasping screech of the older type."

Wage statistics for June

The Interstate Commerce Commission's summary of reports of wage statistics filed by Class I steam roads shows a total of 1,833,621 employees as of the middle of June, 1926, an increase of 24,893, or 1.4 per cent over the number for the previous month. The total compensation $249,055,495 shows an increase of $2,518,261, or 1.0 per cent. The number of employees reported in June, 1926, in comparison with the returns for the corresponding month last year, shows an increase of 2.9 per cent. The compensation increased 3.8 per cent. The greater percentage increase in compensation is due principally to an increase in the average number of hours worked per employee.

New equipment

The Chicago & North Western has authorized the purchase of 100 steel coaches, 20 steel combination baggage and smoking cars, 10, 70-ft. steel baggage cars, and three, 70-ft. combination baggage and smoking cars. The rebuilding of 35 steel passenger cars also has been authorized. This company has ordered two baggage and dormitory cars from the American Car & Foundry Company.

The New York Central has placed orders for 124 cars for passenger service as follows:

New York Central.	10 coaches	Pullman Car & Mfg. Corp.
	3 passenger and baggage.	Amer. Car & Foundry Co.
	30 suburban coaches.....	Osgood-Bradley Car Co.
	2 suburban passenger and baggage.	Osgood-Bradley Car Co.
	2 suburban pass., bagg. and mail.	Osgood-Bradley Car Co.
	20 milk	Merchants Despatch, Inc.
Michigan Central.	10 coaches	Pullman Car & Mfg. Corp.
	10 baggage 69 ft. 3 in.	Amer. Car & Foundry Co.
Boston & Albany.	10 coaches	Pullman Car & Mfg. Corp.
	2 passenger and baggage.	Amer. Car & Foundry Co.
	10 baggage 60 ft. 6 in.	Amer. Car & Foundry Co.
Pittsburgh & Lake Erie	10 coaches	Amer. Car & Foundry Co.
	5 baggage and mail.....	Amer. Car & Foundry Co.

Fuel statistics

Class I railroads consumed 49,935,063 net tons of coal and 990,537,707 gallons of oil as fuel for road locomotives in the first six months of 1926, according to the Interstate Commerce Commission's monthly compilation of railroad fuel statistics. This compares with 47,404,406 tons of coal and 982,053,985 gallons of oil in the corresponding period of last year. The figures apply only to fuel charged to operating expenses and do not include switching service.

Although more fuel was consumed than in the first six months of last year the total cost was less; $160,076,809 as compared with $162,962,196. The average cost of coal per ton decreased from $2.78 to $2.63 while the average cost of oil decreased from 3.17 cents per gallon to 2.91 cents. The cost of the coal used was $131,291,648 and the cost of the oil was $28,785,161.

For the month of June the average cost of coal was $2.61 as compared with $2.70 last June and the average cost of oil was 2.92 cents as compared with 3.30 cents last June. For the month of June alone the total cost of coal and oil was $24,247,192.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treatment.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

Birmingham Car Foremen and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. Building. Next meeting October 11.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting October 12, 8:30 p. m. Paper on the fuel problem of Canada will be presented by Leslie R. Thomson, consulting engineer, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Annual meeting Oct. 11, Morrison Hotel, Chicago.

Car Foremen's Association of St. Louis.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis. Next meeting October 12, at 8 p. m. Paper on A. R. A. billing will be presented by Z. F. Mitchell of the St. Louis-Southwestern.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

Cincinnati Railway Club.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting Nov. 9, Hotel Gibson, Cincinnati.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting October 4. R. V. Wright, editor of the *Railway Mechanical Engineer*, will present a paper on improving the standards of supervision.

International Railroad Master Blacksmith's Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 1809 Capital Ave., Omaha, Neb.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting October 5. Percy Todd, president, Bangor & Aroostook, will be the speaker.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August at 29 West Thirty-ninth St., New York. Next meeting October 15. N. C. Miller, director, Rutgers University, New Brunswick, N. J., will present a paper touching upon the foreman training problem.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Car Department Officers' Association.—A. S. Sternberg, Belt Railway Clearing Station, Chicago.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting November 18, Ansley Hotel, Atlanta.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month Terminal Hotel Bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 189 W. Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Oakley Chemical Company, New York City, has changed its name to Oakite Products, Inc.

William C. Bergman, president of the Parsons Company, Newton, Iowa, died on August 23.

The Wayne Tank & Pump Company, Fort Wayne, Ind., is preparing plans for a two-story plant, 62 ft. by 86 ft.

R. H. Rich has been appointed advertising manager of the Cleveland Automatic Machine Company, Cleveland, Ohio.

James H. Watters, assistant to the president of the New York Air Brake Company, New York, has been elected a vice-president.

Lauren J. Drake, president of the Galena Signal Oil Company, has been elected president of the Union Tank Car Company, with headquarters at Chicago, to succeed E. C. Sicardi, retired. H. E. Felton remains chairman of the board of directors. Lauren J. Drake was born at Keokuk, Iowa, on August 27, 1880. After attending public schools in Omaha, Neb., and Chicago, Ill., he became a student at the Shattuck Military School, Faribault, Minn., graduating in 1899. Mr. Drake then entered the oil business, acquiring by service with several important oil companies, a general and broad knowledge of the business in all its branches, specializing in the marketing end of the business. In 1905, he went to the Galena Signal Oil Company as a representative in the middle west and served until 1916, when he went to its executive offices in New York as vice-president and director of the company. On February 24, 1920, Mr. Drake was elected president of the Galena Signal Oil Company, with headquarters at New York.

L. J. Drake

Walter Hallen, with offices at 30 Church street, New York, has been appointed representative in that territory of the Wooding Forge & Tool Company, Verona, Pa.

Henry Robbins Wardell, a director and consultant on roofing and waterproofing material for Johns-Manville, Inc., New York, died on September 13 at Loon Lake, N. Y.

Bruce Owens, sales manager of the Magnus Company, Inc., with headquarters at Chicago, has resigned to become vice-president of the O'Malley Beare Valve Corporation, Chicago.

John R. Blair, of the sales department of the Pittsburgh Steel Products Company, Pittsburgh, Pa., has been appointed manager of sales, to succeed Charles F. Palmer, who has resigned.

Ralph J. Stayman, district sales manager in charge of the warehouse at Chicago for the Jones & Laughlin Steel Corporation, has been promoted to general manager of warehouses, a newly created position.

C. W. Sullivan has been appointed western representative of Leslie Company, with headquarters at 565 West Washington Boulevard, Chicago, succeeding J. J. Cizek, who has been appointed vice-president, with headquarters at Lyndhurst, N. J.

The Logan Iron & Steel Co., Philadelphia, has appointed J. T. Stephenson, who has headquarters in the Munsey building at Washington, D. C., as its selling agent for the territory from Baltimore, Md., south to Atlanta, Ga., and Wilmington, N. C.

B. M. Cheney, president of Laughlin & Cheney, Inc., Chicago, sales agents for the Verona Tool Works, Pittsburgh, Pa., and other companies, has been appointed district sales manager of the Verona Company, with headquarters at Chicago, and the firm of Laughlin & Cheney, Inc., has been dissolved.

R. C. Simmons, formerly manager of the Seattle district of Johns-Manville, Incorporated, has been transferred to the New England territory, handling the railroad and the United States Government work. Mr. Simmons is associated with C. D. Folsom, of Johns-Manville, Incorporated, at 55 High street, Boston, Mass.

H. E. Graham has been appointed an assistant vice-president of the American Car & Foundry Company and will be associated with the sales department at New York. Mr. Graham was formerly connected with the Pressed Steel Car Company and later was vice-president in charge of sales of the Standard Tank Car Company.

Col. Leonard S. Horner has resigned as vice-president and manager of sales of the Acme Wire Company, New Haven, Conn., and has been elected president of the Niles-Bement-Pond Company, New York, succeeding James K. Cullen who has resigned to devote his entire time to his activities as president and general manager of the Niles Tool Works. Colonel Horner was born at Marshall, Va., on March 26, 1875. He attended the Bethel Military Academy and is a graduate in electrical engineering of Lehigh University, class of 1898. After his graduation he was employed by the American Telephone & Telegraph Company as construction engineer and was later electrical engineer and sales manager of the Crocker-Wheeler Company. He is now a director of the Crocker-Wheeler Company, the Acme Wire Company, and the Pratt & Whitney Aircraft Company of Hartford, Conn.; vice-president of the New Haven Chamber of Commerce; a counsellor of the United States Chamber of Commerce, and a member of the Board of Aviation. He served in the Spanish-American War with Troop A, New York Cavalry. During the World War he enlisted in the Signal Corps, Air Service Division, being commissioned major and put in charge of the manufacturing facilities and production of Liberty engines, airplanes, airplane machine guns and other airplane accessories. After serving in this capacity for eight months, he became a lieutenant-colonel and chief of staff to the commanding officer of Aircraft production. Colonel Horner's efforts in the production of Liberty motors and airplanes resulted in his being cited by the British Government for meritorious service.

Col. L. S. Horner

Harry Keith Mask, assistant to the vice-president of the Nathan Manufacturing Company, New York, and at one time assistant road foreman of the Maryland division of the Pennsylvania, died at the home of his sister in Wilmington, Del., on August 31, 1926. Mr. Mask was born in Cecil county, Maryland, but spent a greater part of his life in Wilmington until, 20 years ago, he moved to New York.

The Pyrotung Manufacturing Company has been organized recently and a new plant built at 730 W. 50th street, Chicago, for the manufacture of railroad track drills and shop cutting tools. These tools are made by the new Pyrotung process, designed to give unusual toughness and hardness without brittleness. The officers of the new company are: W. R. Otis, president; C. E. Sutten, vice-president; B. C. Cleveland, vice-president and metallurgical engineer, and C. E. Pynchon, general manager, formerly manager of the machinery and tool departments of J. T. Ryerson & Son, Inc.

Trade Publications

MOTORS.—The General Electric Company, Schenectady, N. Y., has issued two bulletins descriptive of its Type CO-1820 direct-current crane and hoist motors and its "900 series" wound rotor induction motors.

PIPE FAILURES.—Extracts from a committee report of the Air Brake Association are incorporated in a pamphlet entitled "Pipe failures in railway service," which has been prepared by the A. M. Byers Company, Pittsburgh, Pa.

I-BEAM TROLLEYS.—The Northern Engineering Works, 210 Chene street, Detroit, Mich., has issued an eight-page bulletin describing in detail the construction of its all-steel I-beam trolleys equipped with Hyatt roller bearings.

TOOL STEEL HANDBOOK.—The Ludlum Steel Company, Watervliet, N. Y., has issued the second edition of its tool steel handbook, describing in detail carbon, alloy, rust and heat treating steels; their use; methods of treating, etc.

DROP PIT TABLE.—The construction and operation of the Whiting electric drop pit table for locomotive and car shops, its advantages and savings, are described in Catalogue No. 177 issued by the Whiting Corporation, Harvey, Ill.

GAIRING TOOLS.—Catalogue No. 19 describing its complete line of tools, which include counterbores, spotfacers, core drills, etc., has been issued by the Gairing Tool Company, Detroit, Mich. Price lists also are included in this 78-page, illustrated catalogue.

PIPE THREADING.—The new Red-E-Hall portable pipe threader is described and illustrated in a 12-page catalogue which has been issued by Hall-Will, Inc., Erie, Pa. This machine is adaptable for use in industrial plants, railroad shops, electrical power stations, etc.

TRAVELING GRATE STOKER.—The construction and operation of the Coxe stoker for boilers from 150 hp. up are described and illustrated in Catalogue C-4 which has been issued by the Combustion Engineering Corporation, 43 Broad street, New York. This stoker is designed to burn a wide range of fuels, especially small sizes of anthracite coal and coke breeze.

PIPE TOOLS AND MACHINES.—A complete catalogue, List No. 35, including such new additions to the Oster line as the quick acting vise and the special type reamer and single wheel cutter for use with mechanical drives, has been issued by the Oster Manufacturing Company, Cleveland, Ohio. The catalogue contains 48 illustrated pages, and a thumb index is provided.

DIE HEADS.—"18 vital questions to ask when selecting a die head" is the title of an interesting publication which has been prepared by the Eastern Machine Screw Corporation, New Haven, Conn. The questions are ones which any purchasing agent, superintendent, master mechanic, foreman or operator should ask when considering the selection of self-opening die heads. Tables in this booklet show the principal dimensions of H. & G. die heads.

PLUG VALVES.—The Merco Nordstrom Valve Company, 121 Second street, San Francisco, Cal., has issued Catalogue No. 5 descriptive of its straight way, three way, and four way plug valves and Merco Nordstrom wrenches for plug valves. These plug valves are made of semi-steel, all iron, cast steel, mercoloy, bronze, or aluminum, and are provided with lubricants adapted to all kinds of service. The lubricants are prepared in cartridge form.

ELECTRIC EQUIPMENT.—Complete information on locomotive headlight mountings and recommended wiring for locomotive lighting, etc., together with tables, diagrams and material lists, is presented in the third edition of catalogue No. 101 which has been completed by the Pyle-National Company, 1334 North Kostner avenue, Chicago. A number of recent developments in locomotive headlight case construction are described in this edition, which includes also data on the Pyle-National line of turbo-generators and yard floodlights and a representative selection of the Oliver wiring appliances for locomotive, car and shop wiring.

Personal Mention

General

G. G. Ritchie has been appointed chief fuel inspector of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding S. Hernaman, retired.

R. M. Brown, assistant superintendent of motive power of the New York Central at New York, has been appointed superintendent of motive power, with the same headquarters.

E. L. Kerlin has been appointed traveling engineer of the Wisconsin division of the Illinois Central, with headquarters at Freeport, Ill., succeeding W. T. Getty, retired.

M. W. Hassett, general master mechanic of the New York Central at Buffalo, N. Y., has been appointed assistant superintendent of motive power, with headquarters in New York.

W. H. Flynn, superintendent of motive power of the New York Central, with headquarters in New York, has been appointed general superintendent of motive power, with the same headquarters.

E. W. Smith, general superintendent of the Western Pennsylvania division of the Pennsylvania at Pittsburgh, Pa., has been appointed general manager of the Eastern Region. Mr. Smith was born in Clarksburg, W. Va., on September 21, 1885. He was graduated from the Virginia Polytechnic Institute in 1905, and entered railroad service with the Pennsylvania on June 1, 1905. After being advanced through several grades in the motive power department, he served as assistant master mechanic, with headquarters at Wilmington, Del., from October, 1913, to April, 1915. On April 19, 1915, he was transferred to the Altoona, Pa., shops where he served as assistant master mechanic until July, 1916, when he became assistant engineer of motive power. On October 10, 1917, he was transferred to Harrisburg, Pa., as master mechanic in which capacity he served until May 26, 1918, when he was transferred to Williamsport, Pa., where he served as superintendent of motive power. On December 1, 1919, he was transferred to Altoona, Pa., as superintendent of motive power, and on March 1, 1920, he was promoted to engineer of transportation on the staff of the vice-president in charge of operation, with headquarters in Philadelphia. He was appointed general superintendent of motive power, with headquarters at St. Louis, Mo., October 15, 1922, and in June, 1924, was promoted to general superintendent of the Western Pennsylvania division.

E. W. Smith

Hal G. Foster, traveling storekeeper of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been transferred to the staff of the vice-president, with the same headquarters, and will be succeeded by C. J. Mackie.

O. A. Garber, mechanical superintendent of the Missouri Pacific at St. Louis, Mo., has been promoted to assistant chief mechanical officer of the Missouri Pacific, with headquarters at St. Louis, Mo. Mr. Garber was born on October 15, 1874, and entered railway service in 1891 as a machinist apprentice on the Wabash at Springfield, Ill. After 10 years' service in this capacity he was promoted to erecting and roundhouse foreman on the Baltimore & Ohio at Lorain, Ohio. From 1903 to 1909, he served in a similar position on the Illinois Central at Paducah, Ky., and in 1909 he was promoted to general foreman at Mounds, Ky., later being transferred to Paducah, where he remained until 1912, when he was promoted to master mechanic at East St. Louis, Ill. In 1918 he was transferred to Waterloo, Iowa, and later to Memphis, Tenn., where he remained until March, 1925. He was then appointed mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis.

A. P. Housholder, master mechanic of the Missouri Pacific at St. Louis, Mo., has been promoted to mechanical superintendent of the Texas lines of the Missouri Pacific, with headquarters at Houston, Tex. Mr. Housholder was born on November 7, 1879, and began railroad work in 1894 as a machinist apprentice on the Southern at Knoxville, Tenn. In 1898 he was promoted to machinist at Salisbury, N. C., serving there and at Knoxville, Tenn., until 1899, when he became machinist on the Illinois Central at Paducah, Ky. He remained here until 1904, when he became a machinist on the Missouri Pacific at St. Louis, Mo. In 1906, he was promoted to roundhouse foreman at Jefferson City, Mo., later being transferred to St. Louis, where he remained until 1909, when he was appointed general foreman of the Illinois Central, with headquarters at East St. Louis, Ill. In 1912 he was appointed division foreman on the Missouri Pacific at Dupo, Ill., and seven years later he was promoted to acting master mechanic, with headquarters at Nevada, Mo. He was promoted to master mechanic at Nevada in 1919, later being transferred to DeSotto, Mo., and then to St. Louis.

E. F. Stroeh, superintendent of shops of the Missouri Pacific at North Little Rock, Ark., has been promoted to mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis, Mo. Mr. Stroeh was born on November 24, 1876. He entered railway service in 1891, as a machinist apprentice with the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, Ohio, and was promoted to machinist before entering the service of the St. Louis, Iron Mountain & Southern in 1897 as a machinist and work equipment inspector. In 1901, he was promoted to roundhouse foreman at Alexandria, La., where he remained until 1903, when he entered the service of the Louisville & Nashville at Paris, Tenn., as a machinist, later serving in the same capacity on the Illinois Central at McComb, Miss. In 1903 he became machinist and air brake inspector on the Louisville & Nashville at Decatur, Ala., and in the same year was appointed machinist and division foreman on the Illinois Central at Paducah, Ky. Later he served until 1910 successively as roundhouse and machine foreman at Fulton, Ky., and as general foreman at Memphis, Tenn. From 1910 to 1912, he was foreman and superintendent of shops on the Missouri Pacific at Hoisington, Kan. when he was promoted to master mechanic at Kansas City, Mo., where he served until 1917. In that year he was promoted to superintendent of the North Little Rock, Ark., shops.

Master Mechanics and Road Foremen

F. R. Butts has been appointed assistant master mechanic of the Brookfield division of the Chicago, Burlington & Quincy, with headquarters at Brookfield.

H. W. Reinhardt, master mechanic of the Missouri Pacific at Monroe, La., has been transferred as master mechanic to North Little Rock, Ark., succeeding J. M. Whalen.

J. M. Whalen, master mechanic of the Missouri Pacific at North Little Rock, Ark., has been transferred as master mechanic to Houston, Tex., succeeding A. P. Housholder.

J. P. Roquemore, mechanical superintendent of the Missouri Pacific at Houston, Tex., has been promoted to master mechanic, with headquarters at Monroe, La., succeeding H. W. Reinhardt.

W. C. Smith, assistant to the chief mechanical officer of the Missouri Pacific at St. Louis, Mo., has been promoted to master mechanic, with headquarters at Hoisington, Kan., succeeding W. H. McAmis.

J. C. Stump, general foreman at Butler, Wis., has been promoted to master mechanic of the Peninsula division of the Chicago & North Western, with headquarters at Escanaba, Mich., succeeding C. S. Jones.

Roston Tuck has been appointed acting master mechanic of the Arizona division of the Atchison, Topeka & Santa Fe, with

headquarters at Needles, Cal., succeeding G. Searle, who has been granted leave of absence.

C. S. Jones, master mechanic of the Peninsula division of the Chicago & North Western at Escanaba, Mich., has been transferred to the Galena division, with headquarters at Chicago, succeeding Hugh Morris, deceased.

W. A. Langlands, general foreman of the Galena division of the Chicago & North Western at Chicago, has been promoted to master mechanic of the Chicago terminal, with the same headquarters, to succeed W. R. Smith, deceased.

H. H. Urbach, master mechanic of the McCook division of the Missouri Pacific, with headquarters at McCook, Nebr., has been promoted to assistant superintendent of motive power of the lines east of the Missouri river, with headquarters at Chicago.

O. E. Ward, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Alliance, Nebr., has been promoted to superintendent of motive power, Lines west, with headquarters at Omaha, to succeed T. Roope, who has been granted a furlough.

T. E. Paradise, master mechanic of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., has been given jurisdiction also over the Brookfield division which has been consolidated with the Hannibal division.

Car Department

D. D. McClure has been appointed master car repairer of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Cal., succeeding Frank Roehr.

Frank Roehr, master car repairer of the San Joaquin division of the Southern Pacific, at Bakersfield, Cal., has been transferred to the Los Angeles division, with headquarters at Los Angeles, Cal.

Shop and Enginehouse

William Henry McAmis, master mechanic of the Missouri Pacific at Hoisington, Kan., has been promoted to superintendent of shops, with headquarters at North Little Rock, Ark., succeeding E. F. Stroeh. Mr. McAmis was born on February 7, 1879, at Rising Fawn, Ga. He received a high school education and on April 1, 1894, entered railroad service as a machinist on the Alabama Midland, now a part of the Atlantic Coast Line at Montgomery, Ala. From 1903 to 1907 he served successively as machinist, foreman and general foreman of the Louisville & Nashville. Subsequently he was machinist supervisor, general foreman and master mechanic of the Central of Georgia at Columbus and Macon, Ga., until 1919 when he became lubricating expert of the Texas Oil Company. From 1921 to 1924 he was general foreman of the Gulf, Mobile & Northern, and during the latter year became master mechanic of the Missouri Pacific at Hoisington.

Purchases and Stores

G. A. Goerner, storekeeper of the Chicago, Burlington & Quincy at Denver, Colo., has been transferred to Aurora, Ill., succeeding C. J. Mackie.

C. C. Kyle, general storekeeper of the Northern Pacific at St. Paul has been promoted to purchasing agent, with the same headquarters, succeeding R. J. Elliott.

C. J. Mackie, storekeeper of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed traveling storekeeper, with headquarters at Chicago, succeeding Hal G. Foster.

C. E. Swanson, acting storekeeper of the Chicago, Burlington & Quincy at Casper, Wyo., has been appointed storekeeper, with headquarters at Denver, Colo., succeeding G. A. Goerner.

R. J. Elliott, purchasing agent of the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to director of purchases, with the same headquarters, and will be succeeded by C. C. Kyle.

Obituary

Robert F. Moffett, general car inspector of the Gulf Coast Lines, died at his home in Houston, Tex., on September 16.

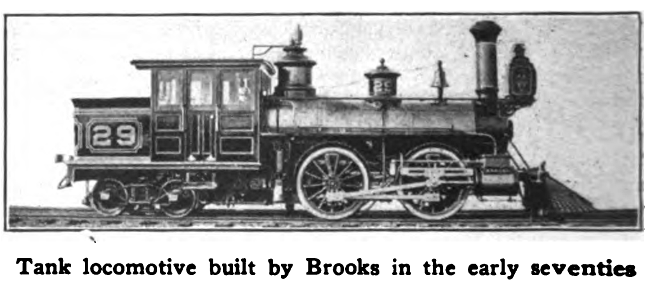
William O. Cook, who retired as a master mechanic on the Denver & Rio Grande Western, in 1925, died on September 18, at Denver, Colo.

H. Morris, master mechanic on the Galena division of the Chicago & North Western, with headquarters at Chicago, died on September 10, at Chicago, following an operation.

W. R. Smith, master mechanic at the Chicago Terminal of the Chicago & North Western, with headquarters at Chicago, died on September 11, at Chicago, following a short illness.

William Henry Fetner, chief mechanical officer of the Missouri Pacific, died at his home in St. Louis, Mo., on September 7, following an illness of several months. Mr. Fetner was born on September 1, 1867, at Columbia, S. C., and was educated in the public schools there. He began his railroad career with the Illinois Central in May, 1881, at Water Valley, Miss., and was consecutively, until 1892, machinist, gang foreman and locomotive engineer with the Southern at Columbia, S. C. In 1892, he became a gang foreman in the shops of the Central of Georgia at Macon, Ga., and he served successively at the same place as erecting shop foreman, general foreman and master mechanic. Later he was promoted to master mechanic for the entire system and on November 16, 1917, he was promoted to superintendent of motive power, with headquarters at Savannah, Ga. He held that position until July 16, 1923, when he was appointed assistant to the president of the Missouri Pacific. On April 1, 1924, he was appointed chief mechanical officer, with headquarters at St. Louis, Mo.

William A. Nettleton, formerly superintendent of motive power of the Chicago, Rock Island & Pacific, died during a trip abroad in London, Eng., on August 30. Mr. Nettleton was born in October, 1863, at Hannibal, Mo. He attended Phillips Andover Academy and was graduated from Yale University in 1885, entering railway service in the same year and serving as rodman and levelman on the Kansas City, Ft. Scott & Memphis (now a part of the St. Louis-San Francisco). In 1886, he entered a student course with the Westinghouse Air Brake Company, and in the next year was appointed inspector of air brakes of the Kansas City, Ft. Scott & Memphis. After a further student course with the Union Bridge Company at New York, Mr. Nettleton was inspector for the Morison & Corthell Union Bridge Company, at Athens, Pa., and for C. A. Boller on the Thames river bridge at New London, Conn. From October, 1889, to May, 1892, he was engineer of tests of the Kansas City, Ft. Scott & Memphis and until August, 1893, superintendent of terminals of the Kansas City & Memphis Railway & Bridge Company, at Memphis, Tenn. For the next two years he served as assistant superintendent of motive power, and in 1895, was promoted to superintendent of motive power and machinery. In January, 1902, he entered the service of the Atchison, Topeka & Santa Fe, serving as assistant superintendent of motive power and consulting engineer until May, 1904, when he was made general superintendent of motive power of the St. Louis-San Francisco and the Chicago & Eastern Illinois. Mr. Nettleton was appointed general superintendent of motive power of the Chicago, Rock Island & Pacific, in March, 1908, which position he held until his retirement in 1911. He was a son of the late George H. Nettleton, who built the Kansas City, Ft. Scott & Memphis.



Tank locomotive built by Brooks in the early seventies

Railway Mechanical Engineer

Volume 100 NOVEMBER, 1926 No. 11

Table of Contents

The Pennsylvania's new Mountain type locomotives will be described in the December issue

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Railway Mechanical Engineer

Vol. 100 November, 1926 No. 11

Astonishing advances have been made all along the line on the railways in this country during the years which have elapsed since the close of the world war and particularly since the return of the railroads to their owners after the period of federal control. This advance is particularly noteworthy in the mechanical department in the improvements in the design of cars and locomotives, the better maintenance and utilization of the equipment and the finer spirit of teamwork and co-operation between the men and the managements. The whole standard of management and operation has been raised to a new and much higher level; moreover, the standard of intelligence and education of the boys and young men who are entering the service has been steadily improving. It is therefore more necessary than ever that the foremen and officers should make special efforts to better fit themselves for the positions of responsibility and leadership which they occupy. It is important that they give a certain amount of time to the reading and study of the technical papers and books which can be of the greatest practical value and inspiration to them. One progressive shop superintendent, recognizing this need, has taken a number of technical books from his own personal library and placed them in a bookcase in the general foreman's office as a nucleus for a circulating technical library for the use of the foremen and workers in the plant. The outcome of the experiment will be awaited with much interest. Will the men make good use of this facility unless some enthusiast gets behind it and encourages the men to make use of it? Will the men become sufficiently interested to co-operate in enlarging the collection to make it comprehensive and also of more particular value to some of the special groups in the organization? Has anyone made a similar experiment? To what extent has it succeeded?

The reading of books

All railroad men interested in welding should make a special effort to attend the fall meeting of the American Welding Society to be held in Buffalo, N. Y., November 16, 17, 18 and 19, in connection with which there will be an extensive exhibition and demonstration of welding apparatus, supplies and methods. The technical sessions are being arranged to include papers and discussions pertaining specifically to welding problems of the railroads. Fusion welding received its first impetus on the railroads, which were quick to appreciate its possibilities as a process for quickly and economically repairing certain locomotive parts. As a result of this impetus, many railroad welding men turned to welding as a "cure all," with the result that regulatory bodies have made certain restrictions on welding in the interest of safety. These restrictions, naturally, have slowed up the advancement of the art on the railroads and most of the other metal industries have now far surpassed the railroads in the applications of fusion welding. However, the railroads have now reached a sound basis on which to proceed with the adaptation of welding in the maintenance of locomotives and cars. The period of hesitancy in development work is past. The railroad welding expert has been working out new and safe welding processes, has been improving welding methods, has been experimenting with the latest developments in welding equipment and is now ready to go ahead and take his place in developing the art of welding along with the other industries. Those interested in railroad welding will have a splendid opportunity at the fall meeting of the American Welding Society not only for a profitable exchange of ideas but to learn of the latest developments in equipments and their application.

Fall meeting of Welding Society

A coming event of importance to mechanical department officers is the annual meeting of the Americal Society of Mechanical Engineers which is to be held in the Engineering Societies Building, New York, December 6 to 9, inclusive. An additional attraction is also provided during the same week in the fifth national exposition of power and mechanical engineering, which is being held at the Grand Central Palace. The tentative program for the A. S. M. E. meeting, which is published on another page of this issue, contains a considerable number of subjects that should be of interest to mechanical engineers having to do with railway equipment The two papers being presented by the Railroad Division are not only of a timely nature but the division is fortunate in having them presented by men whose positions eminently fit them to handle their subjects. Professors E. C. Schmidt and J. M. Snodgrass, both on the faculty of the University of Illinois, are scheduled to present a paper on "The use of high steam pressure in locomotives" and L. K. Sillcox, general superintendent of motive power, Chicago, Milwaukee & St. Paul, is to present a paper on the "Balancing factors in use and obligations covering ownership of freight train cars." Some of the papers being presented by the other professional divisions of the society are of value to railway officers and should have many practical applications to mechanical department work.

The annual meeting of the A.S.M.E.

Compared with the many other railway organizations, the American Society of Mechanical Engineers, through its Railroad Division, occupies a unique position inasmuch as it is essentially a professional, rather than an official organization. It provides a common meeting

ground for mechanical engineers in both the railway and railway supply industries where they can discuss railway mechanical engineering problems with which they are mutually concerned. Included in its membership are mechanical engineers engaged in railroad work, in the railroad supply industry, in consulting practice, and as teachers in the technical schools. Many of these men represent the finest mechanical engineering talent in the country. This meeting offers an opportunity not provided by any other convention in the railroad field. Attendance will be well worth the while of every mechanical department officer who believes in the need for intensive future development of railway motive power and rolling stock.

A thought for machine tool builders

It is entirely proper that the efforts of equipment designers and builders should be devoted to the field where the greatest activity in development work is evident. Over a period of the last 10 or 15 years the development of automotive equipment has taken place with such rapid strides that machine tools suitable for the production of such equipment have in many cases become obsolete almost over-night. In contrast, changes which have taken place in railroad shops, while of great importance, have been less spectacular. Anyone familiar with the progress which has been made in such shops realizes that while many shops are now equipped with modern machinery, the great majority of them leave much to be desired in their machine tool equipment when the type of modern motive power now being repaired is taken into consideration.

The railroads have been criticized for being slow to adopt new methods and modern machinery, yet it has been pointed out that this apparent lack of appreciation of modern equipment has not been due entirely to lack of progress on the part of mechanical officers but to a great extent to the fact that limited appropriations often make necessary a severe curtailment of new machine tool installations. Relatively, there is no doubt that the automotive field has offered a more extensive and profitable market to the machine tool builder, but under present conditions, is it not reasonable to suppose that the railroads may offer an increasingly profitable market in comparison to the automotive shops? The rapid development of automotive equipment and the expansion of plants has made it necessary for the machine tool builder constantly to bring out new machines in order to supply the demands of present day production. Is it not possible that the less rapid progress on the part of railroads in rehabilitating their plants has been due to the fact that relatively little effort has been made on the part of machine tool builders to develop machines particularly suited to the class of work which a railroad shop must perform? In all too many cases the effort has been made to sell to the railroads machine tools designed primarily for production work—a type which has a very limited field in the railroad shop.

The modern locomotive with its increasing number of accessories demands much finer machine tool equipment for its maintenance than did its predecessor of some 15 or 20 years ago. It seems well worth while for the machine tool builder to study the particular needs of the railroad shop today with a view to designing special machines particularly capable of handling the class of work which the maintenance of modern motive power demands. It seems reasonable to suppose that with the continued betterment of the railway financial condition the market for machine tools on the railroads should present an opportunity for the builder who is willing to devote his efforts towards supplying the class of machine tool equipment and service that the modern railroad repair shop demands.

Is annealing a restorative for metal fatigue?

When no other readily obvious reason can be found to explain the failure by fracture of axles, crank pins, rods and other steel parts, it is still quite commonly the practice to fall back on the all-inclusive term "crystallization" as a sufficient explanation of the cause of the fracture. The idea back of the long-continued belief in this theory of complete structural change of the material as the result of the repeated variations and reversals of stress, no doubt arose originally from the coarse crystalline structure apparent at the surface of the break which is characteristic of most failures where the section has been gradually reduced by a progressive fracture until the much-overloaded remainder of the section suddenly lets go. This coarse crystalline appearance is in sharp contrast to the fracture of a test specimen of uniform section in a tensile testing machine.

As a corollary of this theory of the process of metal fatigue, it has long been the common practice of many railroads to anneal at more or less regular intervals those parts subject to repeated stress in service, the idea being that the annealing process restores the structure of the metal to its original condition so that it again enters service with an entirely new lease of life.

Recent scientific investigations of the fatigue of metals —notably those which have been under way for some five years past at the Engineering Experiment Station at the University of Illinois,—have brought to light information concerning the changes in metal which ultimately lead to fatigue failure which make it very questionable whether the annealing process is of any value whatever as a means of increasing its life. Examination of the changes in structure under the microscope indicates that when the metal is subject to repeated stresses which reach beyond a certain proportion of its ultimate strength—this proportion depending upon the composition of the metal and its heat treatment—so-called "slip-lines" make their appearance. These "slip-lines" apparently represent changes in the alinement of the material in the crystals themselves which, if not microscopic fractures, at least result in the beginning of fractures within the metal of the section which did not show up at the surface. They do not represent a change in the crystalline structure of the material, but a weakening or failure of the permanently fixed crystals themselves.

Crystallization, therefore, ceases to be an explanation of failure. The coarsely crystalline appearance of the fracture is apparently caused by the comparatively inelastic action at the point of failure because of the sharp reduction in section at this point, rather than from any progressive change in the structure of the metal during the course of its service. It is probably too early to conclude definitely that these "slip-lines" are actually microscopic cracks, but if they are, it is evident that no amount of annealing can restore the original strength of the material. In any event, the fact that they seem to be the first step in the formation of such cracks, which are likely to develop long before the evidence of ultimate failure can be detected at the surface of the metal, is sufficent to indicate that annealing, to say the least, is a useless practice and to suggest very strongly that those whose confidence in the safety of such parts is based on their adherence to the practice of annealing are living in

a fool's paradise. As far as the investigations of this subject have gone, they indicate that safety lies only in keeping the value of the repeated or alternating stresses within a certain proportion of the ultimate strength of the material, below which fatigue changes in the structure do not take place.

Can you afford to make tools?

A trip through almost any railroad shop, particularly the older ones, will reveal the presence of many home-made pieces of shop equipment and tools. Most of these devices serve well their intended purpose, many of them are ingenious and all indicate the initiative of the men in the shop. A railroad repair shop justifies its existence only as a means of maintaining the equipment used in the production of transportation, and in so functioning it falls short of its potential efficiency if certain of its production forces are directed in other channels toward the performance of a task which could more efficiently and economically be performed by some agency better organized for that particular work.

In many cases the apparent necessity for utilizing the labor of a certain portion of a shop's forces in the construction of equipment for use in that shop seems to be the difficulty in securing the approval to purchase equipment especially designed to perform the work for which the home-made equipment is constructed. It is true that the purchase of new shop equipment represents a capital expenditure, whereas in building the equipment with shop forces the actual labor and material charge incurred may, for example, be borne by the maintenance of shop machinery and tools account and finally appear as an operating expense rather than a charge to investment.

The tendency today is toward the reduction of operating expense and the greater utilization of equipment. While the more spectacular strides in this respect have been made through the introduction of modern motive power together with its more intensive utilization, is it not possible that opportunities have been overlooked for effecting substantial economies in the introduction of properly designed modern shop equipment which, by virtue of its having been designed for modern service, will permit greater utilization?

In most instances could not the labor and creative ability devoted to the construction of shop-made equipment be better directed to the improvement of methods for repairing locomotive and cars? And, aside from the possible saving in construction costs, there is also the potential saving in operating costs of devices of this nature, particularly that great number of devices operated by compressed air—one of the most expensive sources of power in the shop.

Improvement in shop methods is certain to result in a demand for improved shop equipment, and where the development of better methods has proceeded along systematic lines, it should not be difficult to determine the economies which the introduction of new equipment would make possible. Modern motive power demands modern shop equipment and machine tools for its successful maintenance. The greater utilization of properly designed shop equipment will reduce the out-of-service time necessary for the maintenance of motive power and rolling stock. An intelligent analysis of present methods should reveal opportunities for effecting operating economies great enough to offset any desirable expenditure for new equipment.

Specialized manufacturing organizations have made possible the remarkable development of the modern locomotive. Other specialized manufacturers stand ready to assist in the reduction of maintenance equipment costs. Can you afford to direct the efforts of a certain portion of your shop organization, the real job of which is repair work, to the manufacturer of equipment that might better be furnished by a manufacturer whose organization is devoted solely to the production of that specialized equipment?

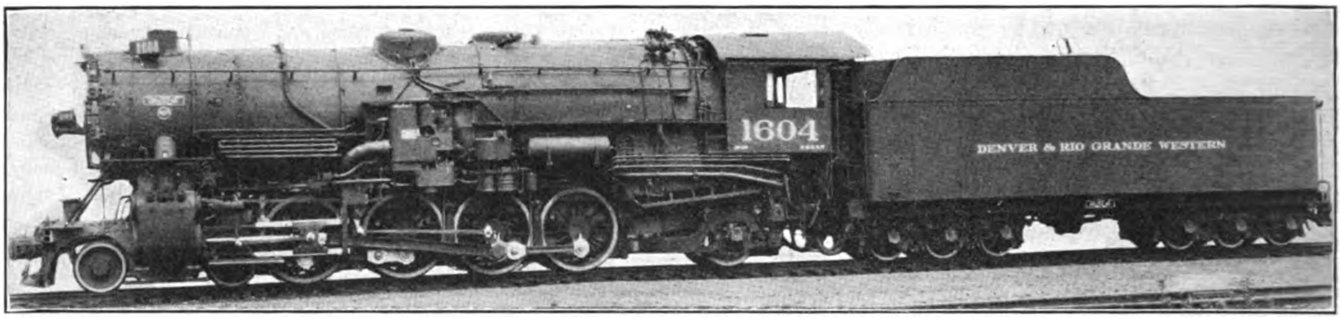
Know what you need, why you need it, determine beyond any doubt what savings will be effected by its introduction, and if the man higher up really wants to save money, your request for purchase will be approved.

Standardizing drafting room practice

A sectional committee is being organized by the American Society of Mechanical Engineers and the Society for the Promotion of Engineering Education, under the direction of the American Engineering Standards Committee, to formulate national standards for drafting room practice. The scope of this committee's project includes such important items as the classification of a corresponding nomenclature for drawings in accordance with their purpose; method of representation of the subject, including the arrangement of views and sections; arrangement of borderline, title, part list, notes, changes and revisions; method of folding and punching prints; kinds and sizes of drawings and filing cabinets; width of rolls of paper and cloth; size of drafting equipment and tools; and specifications for materials to be used for drawing.

Practically all mechanical department drafting rooms with a blue print output of any reasonable proportion have formulated standards to meet their own requirements. Likewise practically all of the railway supply firms have adopted standards for their drawings that have been worked out to suit not only their own shop requirements, but certain demands of the trade and competition as well. This independent policy on the part of the various companies has resulted in considerable waste in both drafting room labor and material. In all probability the railroads are the greatest sufferers, but many railway equipment builders are put to considerable extra expense when they are required to furnish drawings for equipment according to a purchasing railroad's standards. For example, some companies use first angle projection; others use third angle projection. Many railway equipment builders have the title, part lists, revisions, etc., in the upper right hand corner, while it is noted that many railroads locate such information in the lower right hand corner. Of course, the system of filing blue prints has considerable to do with the location of the title, drawing number, etc., and is an item of drafting room practice which is included in the committee's project.

The work that the American Engineering Standards Committee and associated technical societies have undertaken towards obtaining more efficient drafting room practice, might well have the active co-operation of the Mechanical Division, American Railway Association, and also the Railroad Division of the American Society of Mechanical Engineers, either by representation on the sectional committee or by committees within their own organization. It is essential that both the railroad and railroad supply industries be represented in any project to standardize drafting room practice and for that reason the Railroad Division is included among those interested, although the A.S.M.E. is represented as a society. In any case, an opportunity for constructive action towards better drafting room practice is too important for either the railroad or railroad supply industries to overlook.

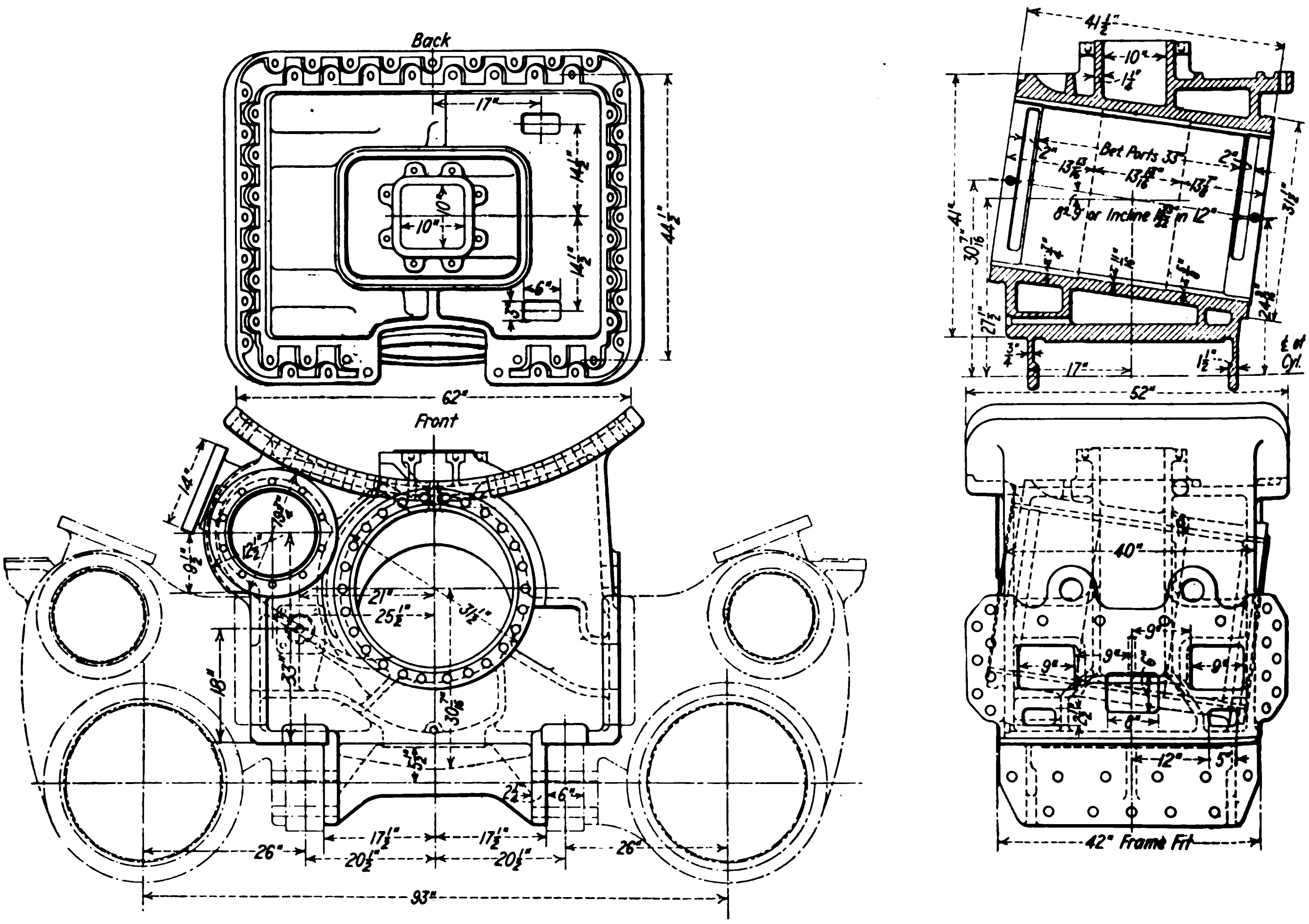


Three-cylinder Mountain type locomotive built for the Denver & Rio Grande Western by the Baldwin Locomotive Works

D. & R. G. W. buys ten three-cylinder locomotives

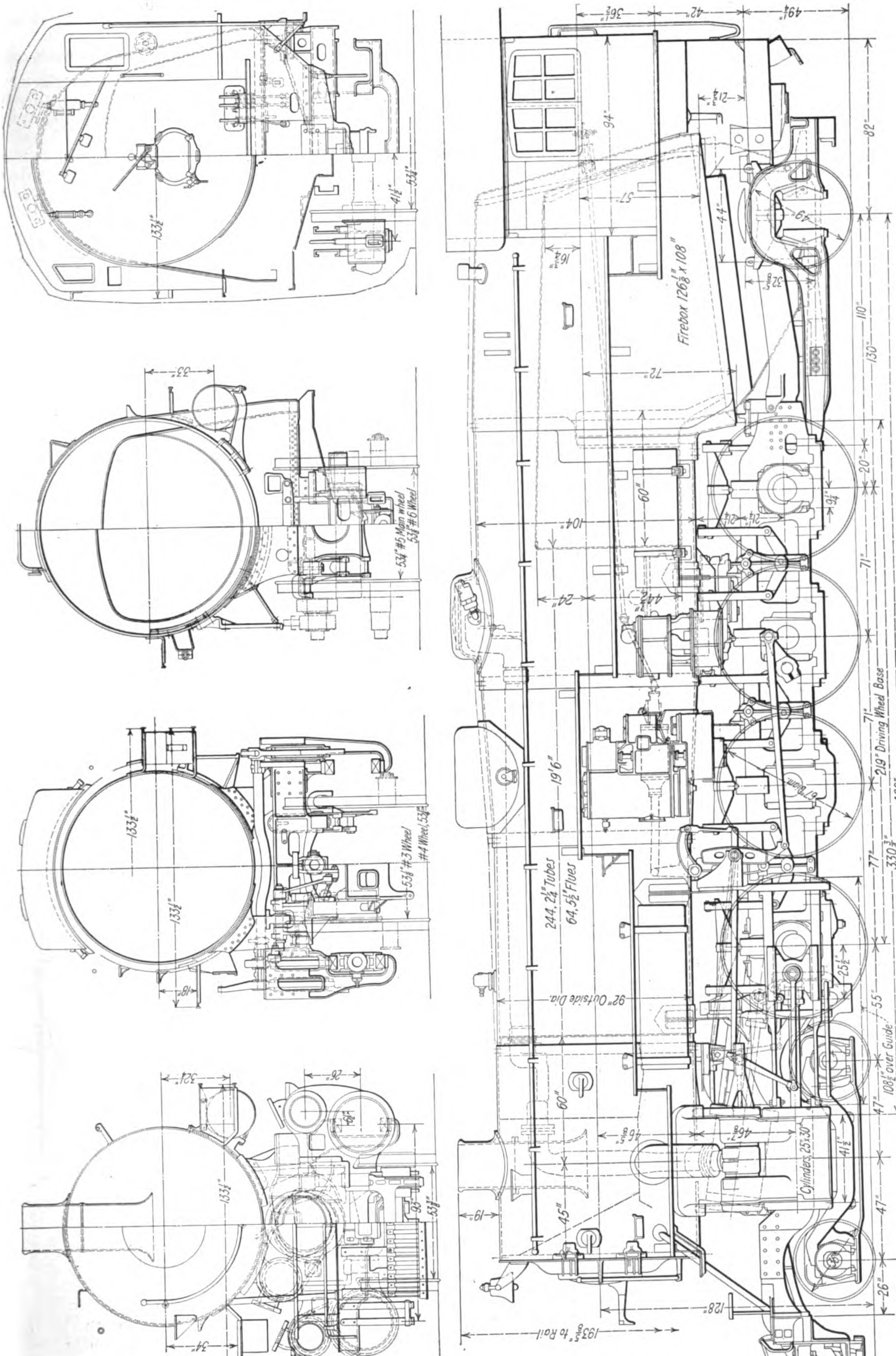
Designed to obtain maximum capacity in 4-8-2 type for heavy passenger service

THE Baldwin Locomotive Works has recently completed an order for ten three-cylinder locomotives for the Denver & Rio Grande Western. These locomotives, one of which was exhibited during the recent convention of the Mechanical Division of the American Railway Association at Atlantic City, are designed to meet the demands of unusually severe operating conditions over a road where the maximum grades are three per cent and the sharpest curves are 16 deg. They develop a maximum tractive force of 75,000 lb. which is exceptional for an eight-coupled design, giving these locomotives a hauling capacity that is exceeded by comparatively few locomotives in freight service.



Drawing showing the construction of the inside cylinders

It was the aim of the designers to obtain maximum capacity in a coal-burning unit of the 4-8-2 type, with-



67,880 lb. 290,530 lb. 60,900 lb.

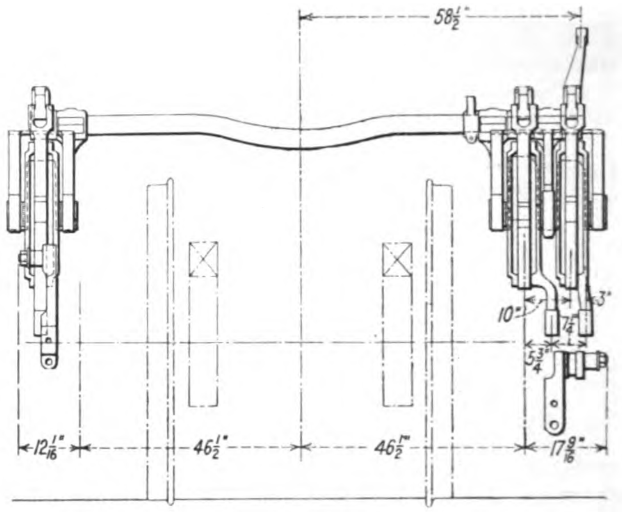
Elevation and cross section drawings of the Denver & Rio Grande Western three-cylinder Mountain type locomotive

out exceeding certain specified weights and clearance limits. To accomplish this it was essential that all superfluous weight be omitted and the detail parts are consequently as light as is consistent with the required strength. The total weight of one of these locomotives is 419,310 lb., of which 290,530 lb. is distributed over the drivers, 67,880 lb. on the engine truck and 60,900 lb. on the trailing truck. All three cylinders are 25 in. by 30 in. and the outside diameter of the driving wheels is 67 in. The boiler pressure is 210 lb. per sq. in.

A novel feature in the design is the construction of the cylinders. The three cylinders are of cast iron and cast separate from each other, the center cylinder being cast in one piece with the saddle. Both sides of the center cylinder casting are flanged to receive the two outside cylinders which are cast from the same pattern. The front frame rails are single, measuring 6 in. in width by 13½ in. in depth. The outside cylinders are bolted securely to the rails and also to the center cylinder casting.

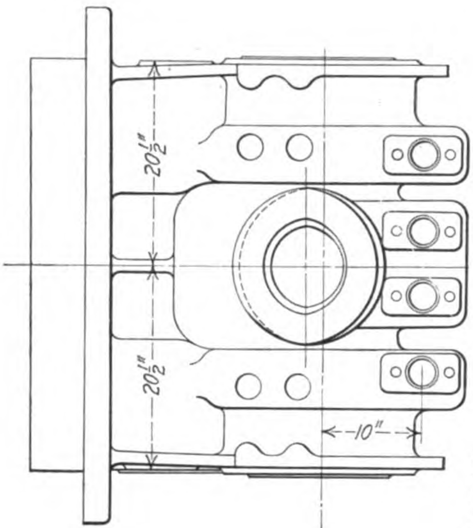
The three cylinders are cast separate from each other

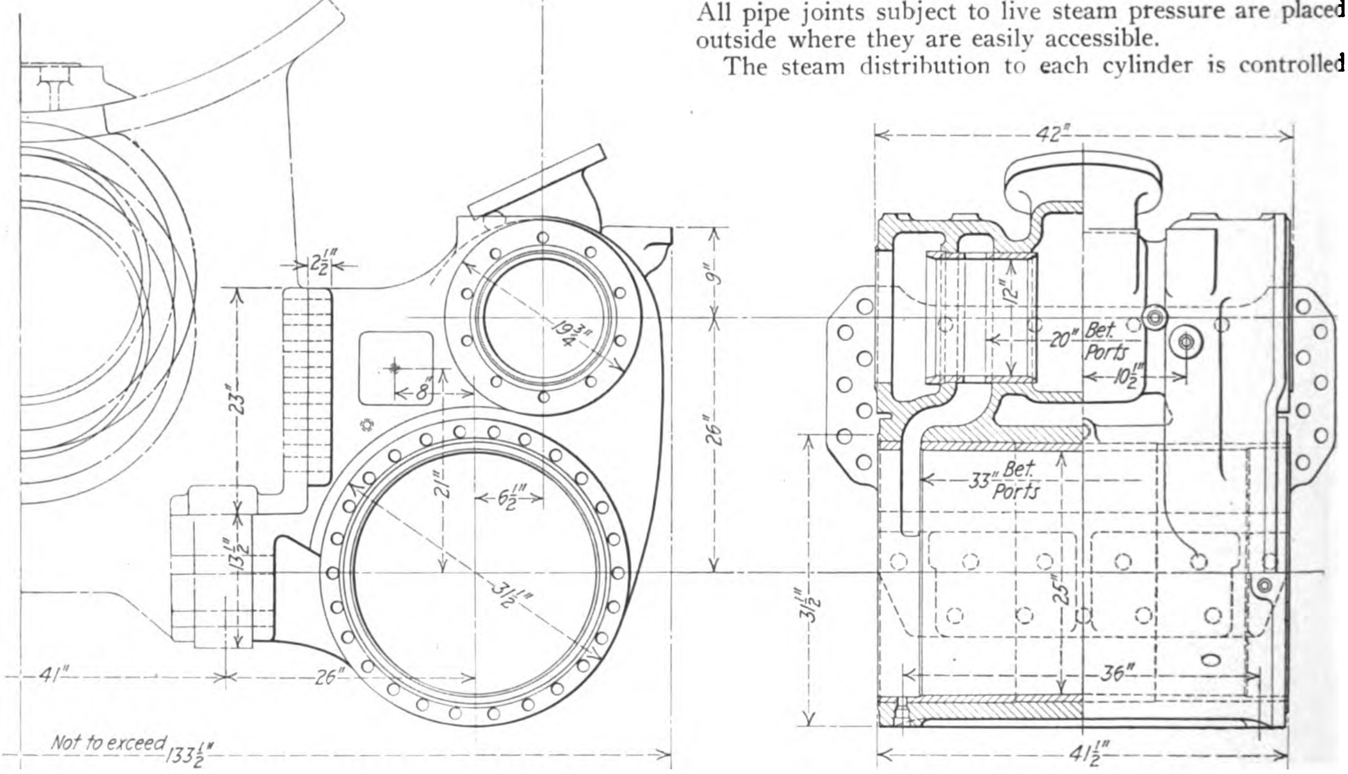
The steam chest for the inside cylinder is placed on the right hand side and receives its steam supply from a branch leading from the right hand steam pipe. The location of this steam chest makes it necessary to run the exhaust passage for the right hand and inside cylinders underneath the latter to the left side of the casting, and then up to the base of the exhaust pipe. All pipe joints subject to live steam pressure are placed outside where they are easily accessible.



The horizontal shaft with left and right side connections

The steam distribution to each cylinder is controlled by a 12-in. piston valve having a steam lap of 1⅛ in. and an exhaust clearance of ¼ in. The valves are set with a travel of 6½ in. and a lead of ¼ in., and are controlled by a Walschaert gear. The motion on the left side is arranged in the usual way; but on the right side the main pin has attached to it a double return





Drawing showing the construction of the outside cylinders

crank which operates two links, one for the inside cylinder and the other for the right hand outside cylinder. The inside valve receives its lead from the corresponding crosshead and the movement is transmitted from the plane of the latter to that of the outside link through a horizontal shaft which is fulcrumed in a rocker, the bearing of which is bolted to the main frames. This horizontal shaft passes through a crosshead to which the inside valve stem is attached. The three valve motions are controlled simultaneously by a power reverse mechanism.

The outside eccentric rod on the right hand side has a solid end of the usual design at the back end, while the inside rod necessarily has a split brass, which is held in place by a cap secured by two horizontal bolts.

The running gear

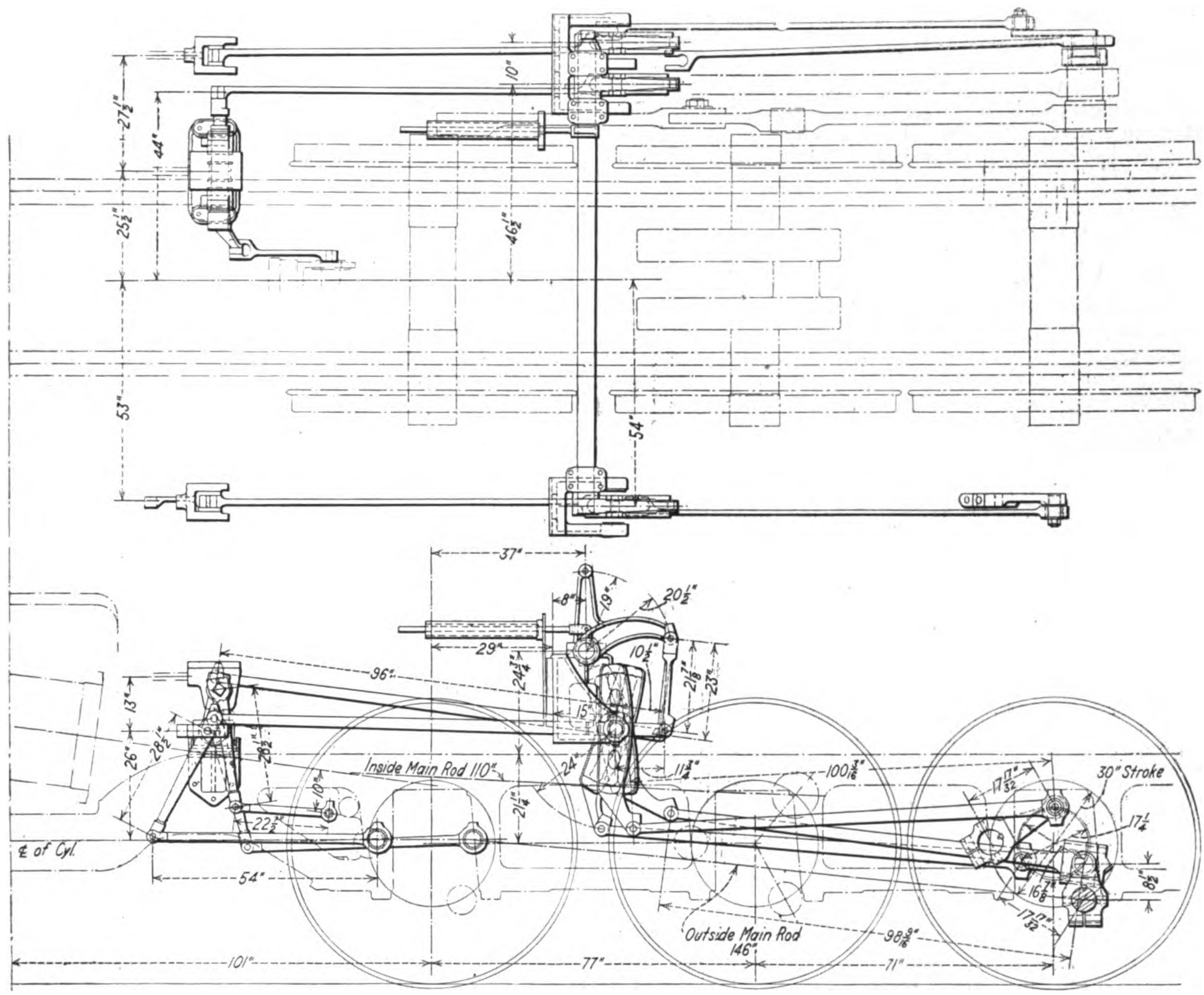
The piston of the inside cylinder is connected to the second pair of drivers and those of the two outside cylinders to the third pair. The outside crossheads are of the alligator type, while the inside one is of the underhung type, this design being used to provide sufficient clearance above the first driving axle. The outside guides and crossheads are unusually long, being 9 ft. ½ in. in length. The guides are supported by two bearers, placed respectively ahead of and behind the leading drivers. The lips of the inside guide, which take the pressure when backing up, are separate pieces secured to the upper shoe of the guide by vertical bolts. This form of construction is amply strong and facilitates machining the various parts.

The main and side rods are of I-section and made of carbon vanadium hammered steel, annealed. The crank pins are of the same material. Floating bushings are used on the main side rod pins and also on the back ends of the outside main rods. The back end of the inside main rod is of the strap type.

The crank axle, a product of the Standard Steel Works Company, Philadelphia, Pa., is of the built up type in five parts; two end pieces, two crank cheeks and the center pin. The pin and axle portions are of normalized carbon vanadium steel and the crank cheeks are of open hearth carbon steel. Cast steel counterweights, filled with lead, are bolted to the cheeks. The three other driving axles are of carbon vanadium steel.

The engine truck is of the Commonwealth constant resistance type and the trailing truck is of the Delta type.

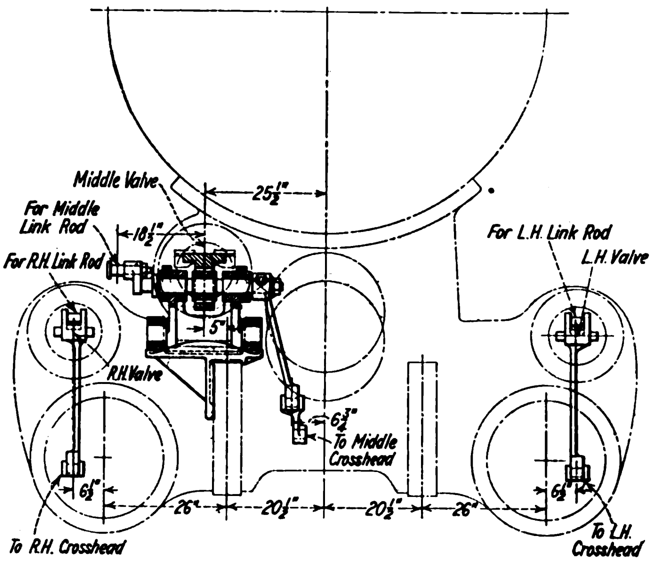
The boiler, apart from its large dimensions, represents no unusual features of design. It is of the conical type,



Side and plan views of the Walschaert valve gear as designed for three-cylinder operation

92 in. outside diameter at the first course and 104 in. outside diameter at the dome course. The firebox is of corresponding size and volume, having a length of 126⅛ in. and a width of 108 in. which makes a grate area of 95 sq. ft. The depth from the crown sheet to the grate surface at the front of the firebox is 96 in.; it is 73¾ in. at the back. There are 244 flues 2¼ in. in diameter and 64 tubes 5½ in. in diameter, the distance over the tube sheets being 19 ft. 6 in. The total evaporative heating surface is 5,093 sq. ft. of which 402 sq. ft. is in the firebox and 5-ft. combustion chamber, 4,581 sq. ft. in the tubes and flues and 25 sq. ft. and 85 sq. ft. in the arch tubes and thermic syphons, respectively. The superheating surface is 1,495 sq. ft.

The boiler accessories include a superheater having 64 elements, two thermic syphons and du Pont-Simplex stokers. The brick arch is supported on the two syphons and three arch tubes. Five of the locomotives are equipped with Worthington feedwater heaters and the other five with the Elesco. The water level is shown by a Sargent three-face water gage. Barco joints are used in the connections between the engine and tender.



Cross section of the valve gear mechanism for the inside cylinder

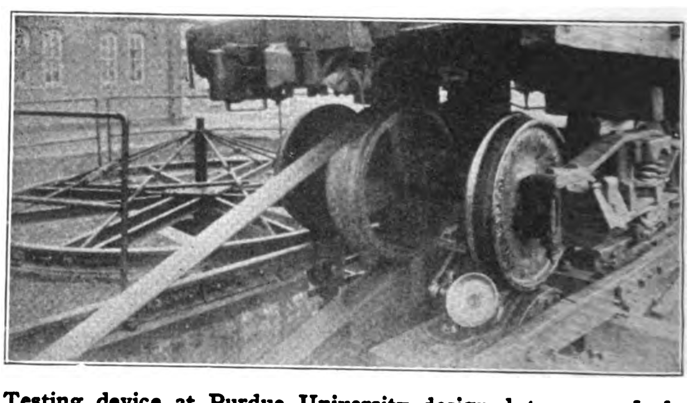
The tender

The stoker engine is mounted on the forward end of the tender instead of on the locomotive, as is the usual practice. The tender, which weighs 297,090 lb. in working order, has a capacity for 15,000 gal. of water and 25 tons of coal. The tank is of rectangular or water leg construction. The trucks are of the six-wheel type, having 36-in. diameter wheels and 6-in. by 11-in. journals.

The builders were assisted in the design of the locomotives by collaboration on the part of J. S. Pyeatt, president, and W. J. O'Neill, general mechanical superintendent, of the Denver & Rio Grande Western.

Table of dimensions, weights and proportions

Railroad	Denver & Rio Grande Western
Builder	Baldwin Locomotive Works
Type of locomotive	4-8-2
Service	Heavy passenger
Cylinders, diameter and stroke	(3) 25 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	6½ in.
Outside lap	1⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Weights in working order:	
On drivers	290,530 lb.
On front truck	67,880 lb.
On trailing truck	60,900 lb.
Total engine	419,310 lb.
Total engine and tender	716,400 lb.
Wheel bases:	
Driving	18 ft. 3 in.
Rigid	11 ft. 10 in.
Total engine	41 ft. 6 in.
Total engine and tender	86 ft. 5 in.
Wheels, diameter outside tires:	
Driving	67 in.
Front truck	36 in.
Trailing truck	49 in.
Journals, diameter and length:	
Driving	11½ in. by 14¼ in.
Front truck	7 in. by 14 in.
Trailing truck	9 in. by 16 in.
Boiler:	
Type	Conical
Steam pressure	210 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	90¼ in.
Firebox, length and width	126¼ in. by 108 in.
Combustion chamber, length	60 in.
Flues, number and diameter	64—5½ in.
Tubes, number and diameter	244—2¼ in.
Length over tube sheets	19 ft. 6 in.
Grate area	95 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	402 sq. ft.
Arch tubes	25 sq. ft.
Thermic syphons	85 sq. ft.
Tubes and flues	4,581 sq. ft.
Total evaporative	5,093 sq. ft.
Superheating	1,495 sq. ft.
Comb. evaporative and superheating	6,588 sq. ft.
Special equipment:	
Feedwater heater	Worthington (5) Elesco (5)
Stoker	du Pont-Simplex, Type B
Tender:	
Water capacity	15,000 gal.
Fuel capacity	25 tons
Journals, diameter and length	6 in. by 11 in.
General data estimated:	
Rated tractive force, 85 per cent.	75,000 lb.
Factor of adhesion	3.88
Cylinder horsepower (Cole)	3,547
Weight proportions:	
Weight on drivers÷total weight engine, per cent.	69.4
Weight on drivers÷tractive force	3.88
Total weight engine÷cylinder hp.	118
Total weight engine÷comb. heating surface	63.8
Boiler proportions:	
Comb. heat. surface÷cylinder hp. per cent.	1.85
Tractive force÷comb. heat. surface	11.4
Tractive force X diam. drivers÷comb. heat. surface	763
Cylinder hp.÷grate area	37.4
Firebox heat. surface÷grate area	5.4



Testing device at Purdue University designed to record the impacts delivered by various lengths of flat spots on car wheels

The car is blocked in position, the wheel with the flat spots rides on a circular revolving track, below which is an indicating apparatus. The mating wheel is carried on an idler. The axle is belted to a motor which may be operated at various speeds. The car is loaded to any desired capacity; the blow delivered by the flat spot is recorded by means of a manograph on a sensitized plate.

Henry Ford and his philosophy*

The third of a series of discussions of books on improved supervision and better employee relations

A MECHANICAL superintendent recently sent us a copy of Mr. Ford's book, "Today and Tomorrow," with the notation, "You will enjoy this—the man problem is much discussed."

The book is more than ordinarily attractive because of the typography; the large type makes for easy reading and the wide margins invite the penciling of notes and comments.

We listened recently to an expert speaking on what to us, at least, and the audience at large, was a most important topic. He held his listeners spell-bound for the first few minutes, but soon got on their nerves because he spoke in such a cocksure fashion and hurled a steady stream of words at us in a loud and high-geared voice. It soon became evident—to the audience, not to the speaker—that they could not stand the strain of trying to assimilate so much good material under such strenuous conditions.

It is hardly fair to apply this criticism to Mr. Ford's book, and yet when we find him emphasizing the extent to which we can improve our practices in almost every respect and pointedly illustrating his statements by citing results obtained with his organization in operating a considerable number and variety of industries; running a railroad; working a farm; building, equipping and operating a hospital; educating our young people and workers in industry, or using our spare time for improvement, it does sort of get on our nerves. Possibly, after all, however, this is a good thing, for usually it is the man who is dissatisfied with his performances and recognizes his shortcomings, that opens up his mind and bucks the line with renewed energy and intelligence. While Mr. Ford does take a good bit of space in explaining his theories or philosophy, we cannot dismiss him as being a theorist, for he has made good to a remarkable degree in his various activities. Indeed one thing that makes the book attractive and fascinating is that he supports his statements of principles with specific examples of accomplishment.

What are his principles? His chapter on "Making a Railroad Pay" is interesting reading for a railroader, although, even Mr. Ford admits that there are special conditions favorable to the D. T. & I. under his ownership. He does in this chapter, however, take the opportunity of summing up or compressing into three statements what he regards as the Ford principle of management. These are:

(1) Do the job in the most direct fashion, without bothering with red tape or any of the ordinary divisions of authority.

(2) Pay every man well—not less than $6 a day—and see that he is employed all the time through 48 hours a week and no longer.

(3) Put all machinery in the best possible condition. Keep it that way and insist upon absolute cleanliness everywhere, in order that a man may learn to respect his tools, his surroundings and himself.

The early pioneers in the field of industrial economics were discredited, to say the least, when they advocated the payment of high wages and low selling prices—in other words, putting the wage earner in a position to buy the products which he makes and to raise his standard of living. "It is this thought of enlarged buying power by paying high wages and the selling at low prices, which is behind the prosperity of this country," says Mr. Ford. Again, in his chapter on "Is There a Limit to Big Business," he says: "But by sharing the profits with the public comes an immediate and great public benefit, there is a stimulating reaction on business, prices go lower, business increases, thousands of men are employed where but scores found work before, wages increase, profits mount."

The problem comes right back on the shoulders of management, because it must devise ways and means of increasing unit production and reducing costs. Several factors are involved in bringing this about and it is impossible in a review of this sort to even touch upon all of them. For one thing methods must be found "by which the entirety may be done by machinery and the man considered only as an attendant upon the machine." . . . "The function of the machine is to liberate man from practical burdens and release his energies to the building of his intellectual and spiritual powers for conquests in the field of thought and higher action. The machine is the symbol of man's mastery of his environment. One has only to go to other lands to see that the only slave left on earth is man minus the machine."

Then, too, it is necessary to secure cheap power and utilize it to the best advantage. "In the organization of the Ford work we are continually reaching out for more and more developed power. We go to the coal fields, to the streams, and to the rivers, always seeking some cheap and convenient source of power which we can transform into electricity, take to the machine, increase the output of the workers, raise their wages, and lower the price to the public."

Another vital factor in Mr. Ford's success is that of standardization and simplification. "No factory is large enough to make two kinds of products," he says. "Our organization is not large enough to make two kinds of motor cars under the same roof." Mr. Ford's one objective is to make a low priced, serviceable car.

The technical man is not highly favored by Mr. Ford, at least in administrative positions. "We call in technical experts," he says, "to aid whenever their aid seems necessary, but no operation is ever directed by a technician, for always he knows far too many things that can't be done. Our invariable reply to 'It can't be done' is 'Go do it.'" And then he goes on to tell how he has worked wonders in improving on the way other people do things, using what he characterizes as "essentially the Edison method of trial and error."

Possibly this review can best be closed with the following quotation: "This work is never more than a man can do without undue fatigue in eight hours. He is well paid—and he works. When management becomes a problem, the fault will be found to be with the planning of the work. Of course, if men are under some outside influence or control, by which the amount of work which they do in a day is limited—if they have to answer to an outside authority—then management is impossible, and consequently, high wages cannot be paid for the production of low priced articles. The whole wage motive fails."

* Today and Tomorrow. By Henry Ford in collaboration with Samuel Crowther. 281 pages, 6½ in. by 9½ in. Bound in cloth. Published by Doubleday, Page & Co., Garden City, N. Y. Price $3.50.

The locomotive of tomorrow

The concluding installment of the papers presented in the Traveling Engineers' symposium at the 1926 convention

In the October number of the *Railway Mechanical Engineer,* page 590, there appeared an account of the symposium on the Locomotive of Today to which the entire second day of the convention of the Traveling Engineers' Association, held at Chicago, September 14 to 17, was devoted. In that article appeared abstracts of the papers presented by W. E. Woodard, vice-president, Lima Locomotive Works; J. B. Ennis, vice-president, American Locomotive Company; A. R. Ayres, assistant general manager, New York, Chicago & St. Louis, and O. S. Jackson, superintendent of motive power and machinery, Union Pacific. These papers essentially dealt with the characteristics of the modern locomotive as it exemplifies the most recently approved developments of the designer, the results which are being obtained in practice by the use of this modern motive power and the best methods of utilizing fully the capacity for service.

In this article are grouped abstracts of the papers presented by W. L. Bean, mechanical manager, New York, New Haven & Hartford; C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe; A. G. Trumbull, chief mechanical engineer, Erie, and John E. Muhlfeld, consulting engineer. These papers may broadly be characterized as dealing, first, with some of the important mechanical problems of detail design which are in need of consideration and, second, with the possibilities for the future development of the steam locomotive which are partially suggested by the present trend of development and partially by fundamental considerations of the transfer and utilization of heat. Taken together, these papers present a remarkable picture of a new era in steam locomotive development, the beginning of which took place not more than four years ago. When it will end or where it will lead is not yet entirely clear, but some indication of its trend may be obtained from the papers which follow.

High tractive effort no longer the only consideration

By W. L. Bean

Mechanical manager, New York, New Haven & Hartford

Former consideration of steam locomotive capacity was almost exclusively on a tractive effort basis, especially by operating officers, and although starting effort should be ample, a locomotive with high starting capacity alone and limited sustained boiler capacity and large cylinders shows up poorly on a *speed-tractive effort* curve or on a *speed-drawbar horsepower* curve. In the days of drag freight operation, the considerations were tractive effort and gross tons, but now they are drawbar horsepower and gross ton miles per train hour.

To produce capacity and economy, under such requirements, additions and refinements utilized in recent years with marked success are those which in principle and practice, particularly in steam production have contributed to advantageous operation of central stations.

Crowded clearances and restrictive weights tax the skill and courage of the locomotive designer heavily in successfully adapting stokers, water tube fireboxes, feedwater heaters, superheaters, "front end" throttles, etc., to a large locomotive but great progress has been made.

Superheating is accepted by managements even to the revamping of older power with increased capacity and economy. Now through experience and further study the designer can utilize improvements in superheating which produce decided further advantages, especially where sustained horsepower at speeds is a requisite.

Augmented superheating surfaces with increased cross section of both gas and steam passages produce surprising results in increased maximum horsepower as well as greater horsepower at faster speeds. High evaporative rates in large locomotives, with relatively short distances between water surface and dry pipe opening produce wet steam. Hence the need for large superheater areas to produce higher average steam temperatures, as well as the other advantages.

Feedwater heating on locomotives fills in an important gap in the heat cycle and yields large returns proportionate to the investment and maintenance cost both through fuel economy and increased boiler capacity. What engineer would consider designing a stationary or marine boiler plant and not use feedwater heaters? Also less foreign matter enters the boiler, and tank capacity is proportionately increased.

Agreement as to application of stokers on heavy power is general and devices currently offered are well designed, are of ample capacity and dependable.

Of interest largely from the maintenance standpoint, integral cast steel versus fabricated constructions yield good returns. Every bolt, nut, key, rivet, pin, or other separate member eliminated initially means trouble and expense avoided. Per cent of availability of power is increased; hazard of accidents reduced; length of total life of members increased. A comparison of the life of tender frames alone is striking.

Unquestionably the next great line of development will be the use of higher steam pressures through water tube construction. Locomotive practice trails that of the central station and even the steamship badly in this respect. Inspection of steam-temperature data shows clearly the advantage of high pressures. Radical design changes not only of the firebox but of construction for absorption of heat by convection are required for handling high boiler pressures. Firebox construction of tubes, drums and hollow foundation ring already service-tested permit of moderate increases in pressure with present boiler barrel constructions, but full utilization means general redesign and hence probably considerable experimentation.

It is recalled that 20 to 35 years ago pressures of 220 to 230 lb. were general with compounding. When the superheater became available and a return to single expansion was made motive power men were glad enough to lower boiler pressures back to 180 to 200 lb. because of maintenance problems with stay-bolted construction.

Now the trend of pressures is very properly headed the other way and while working out the problems of design (including compounding with all its difficulties) in using probably from 600 to 1,800 lb. pressure we can quickly avail ourselves of considerable advantage though using water tube fireboxes already time tried with pressures up to approximately 350 pounds.

One carrier operates two Mikados of 45,000 lb. tractive effort and with 200 lb. pressure built in 1916 and giving good results. It has another, or a Mountain type of 250 lb. pressure built in 1924 and producing splendid results. Recently it placed in service 10 large Mountain types, three of which have three cylinders and all have water tube fireboxes and carry 265 lb. pressure. Further purchases of new power will unquestionably be of water tube construction. These latest 10 engines are doing excellent work particularly those with three cylinders.

A designer of high powered engines will include, among other important factors the following: *A* Higher boiler pressure, *B* Improved type of superheater, including ample and properly proportioned evaporating and superheating areas, *C* Grate area and grate design, D Firebox volume, *E* Special devices for promoting the extent and distribution of circulation of water, *F* Steam storage space (which is small at best), *G* Ample water surface for steam release, *H* Outside dry pipe and front end throttle, *I* Use of superheated steam in stoker engine, air compressor, feed pump and other auxiliaries, *J* Ample cross section areas for steam and gas passage, *K* Limited cut off, *L* Booster, *M* Back pressure gages, *N* Pyrometer, *O* Special care to eliminate air leaks into smoke box, *P* Tender capacities of maximum water and coal capacities.

The last decade has seen remarkable progress in locomotive design leading to new and surprising records of performance almost daily, and with our impetus and continued application of the skill and endeavors of engineers of the locomotive builders, specialty companies and of railroads, one cannot safely venture a prediction of accomplishments to ensue.

The road foreman of engines is a very important factor in capitalizing to the full the opportunities at his command. Continued instruction of enginemen, explanation, demonstration and encouragement in the full and correct use of improved devices are indispensable. Therefore the road foreman by keeping himself fully up-to-date will enhance his value and get keen satisfaction from full accomplishment.

Some details that must not be overlooked

By C. T. Ripley

Chief mechanical engineer, Atchison, Topeka & Santa Fe

There is a temptation for the mechanical engineer to devote too much attention to the consideration of major developments in new locomotives. They are naturally the most interesting and the results are the most spectacular. I do not mean to deprecate their importance, for wonderful things have been and are being done toward improving the thermal efficiency of the modern locomotive. But the essential requirement of a locomotive is that it get over the line without failure. It, therefore, behooves all of us to devote our efforts to accomplishing this result.

Let us first consider the firebox of the locomotive: The grates have been too often looked upon as a finished design. In recent years a number of roads, including our own, have been making an intensive study of the question of grate design and a large field for improvement has been found. I would like here to call attention to the development of the various designs of table grate. This change from the old finger grate is resulting in not only a fuel saving but in much lower maintenance cost. Better distribution of air through the fuel bed means easier and better firing of the locomotive. I am not sure but what a still further step in advance can be made by the introduction of alloy steel in these grates. In the case of oil burners there has been little change in design in the past 20 years, but studies are now being made as to different methods of introducing free air and it appears that by breaking up this air into a large number of small streams, better combustion can be secured.

Expansion stresses in the firebox

The greatest problem we have to meet in the large modern locomotive fireboxes with long combustion chambers, is that of staybolt breakage. The expansion and contraction of the sheets is so great that even the flexible staybolt does not entirely take care of the situation. Just how this is going to be met, I hesitate to predict. The double end flexible bolts may be of help but I am inclined to think that a more intensive study of the movement of the sheets may lead us to some changes in design which will prove of benefit.

In the case of the flues, the electric welding in the sheets has proved to be a marvelous help, but we are still troubled with heavy pitting of flues in bad water districts in spite of all the advances in water treatment. Much study is being given to the protection of flues when engines are laid up for long periods. There are indications that flues deteriorate about as rapidly when laid up as when in service. The methods used by the navy in protecting flues when ships are tied up may be of help in this connection. Storage with the boiler filled with water is preferable to our present practice where weather conditions will permit. Possibly rust inhibitive solutions will answer the requirements.

The front end—a new viewpoint

Passing on to the front end of the locomotive we have a part which is most vital to both thermal and operating efficiency. There are entirely too many air leaks in the front ends. If a water test is put on the front end of an engine just leaving the shop it is surprising to find the number of leaks. We must do everything possible to close up these openings. If we can get rid of the superheater damper, and this is being done on many locomotives without apparent damage to the superheater units, we will eliminate one aggravating source of leak. Better designs of steam pipe casings are being installed. In some of these designs there is practically no chance for leakage.

There is also a tendency to put too much in the front end; we may perhaps learn from the European designers in this connection. The simplicity of their front ends is the most notable feature of their design. Intensive experiments during the past few years have shown us that we can greatly improve the drafting of the locomotive. The low nozzle stand and the large stack are working out very well. In the case of the nozzle itself, the common standard single nozzle has a distinct drawback in that cross fire of the exhaust from the two cylinders produces a hump in the back pressure line which means loss of power. To overcome this there has been developed a double nozzle which has two separate outlets for each cylinder. This results in

the elimination of the increase in back pressure due to crossfiring. The engines are easier to fire and can handle more tonnage and save a small amount in fuel. This device is cheap to install and has no additional maintenance cost.

Too much water is carried over into the steam pipes of large locomotives, particularly those operating in bad water territory and equipped with feed water heaters. The superheaters are made to serve as evaporators and it is surprising to find the low steam temperatures existing at the cylinders in some of our locomotives. Some device is needed to take this water out of the steam. It has been accomplished abroad but on much smaller locomotives.

Frames and moving parts

The frames of the locomotives of older types are entirely too weak for modern service, and, as you all know, failures due to breakage have been common. These should be redesigned with larger sections and as engines pass through the shops they should be re-framed. Unfortunately the designer has a difficult problem in figuring the stresses in frames. All the formulas are more or less empirical and the best guide we have is the record of breakages. It might be well in this connection to take strain gage readings on frames while in service. I believe this would develop the fact that certain portions of the frames are under-stressed and certain portions over-stressed. With this knowledge available we could re-design the frames with the proper distribution of metal. Proper cross bracing of the frames is extremely important in the prevention of frame breakage. The cast steel engine bed which is now being tried out appears to be a very promising development.

In the case of the cylinders our efforts should be directed toward reducing the weight of the moving parts and thus helping lubrication, wear, breakage of parts and proper counter balances. Recent experiments indicate that we can cut the weight of piston heads, rings, etc., from 25 to 50 per cent. We should also cut the weight of the valve motion parts as much as is consistent with the prevention of breakage. It is possible that alloy steel may play an important part in this connection, although in the consideration of alloy steel we must always remember the difficulty of handling this material in railroad blacksmith shops as at present equipped. The future may change this equipment and thus meet this objection.

The need of cross-counterbalancing

In connection with the counterbalancing of the locomotive the track stress tests which have been run in the past few years have developed a very striking fact, that is, the main wheels of our heavy locomotives are improperly balanced under the standard A.R.A. formula. The tests show that the hammer blow on the rail under the main driver occurs when the counterbalance is up, rather than when it is down. This shows that these wheels are not balanced even for revolving weights. The reason for this is that the plane of the counterbalance and of the revolving weights is different. There is, therefore, a moment developed which has been given no consideration in the standard formula. The only correct way to counterbalance is to put a weight in the opposite wheel to take care of this moment. It may be of interest to you to know that a large Santa Fe type locomotive, when cross counterbalanced developed a practically zero hammer blow under the main driver at a speed of 45 miles per hour. The simplest way to approximate the same results is to add more counterbalance directly to each main wheel.

This study opens up a very interesting field for the designer. We are restricted by the track department to certain maximum loads per wheel. These restrictions usually are based on a combination of the static load and the dynamic augment or hammer blow. Now if by proper counterbalancing we can cut down this hammer blow we can increase the static load, thus we have an opportunity to develop the more powerful locomotive which requires higher axle loads without increasing the number of wheels. Incidentally we will get a smoother running locomotive which means lower maintenance cost.

While on this subject, I may note that these same tests developed the fact that the old idea of distributing the load equally over all drivers was incorrect. It was found that lower track stresses result, particularly on sharp curves, by tapering the load to the front and rear drivers.

The driving box is inadequate

One of the greatest weaknesses of our modern locomotive is the main driving box. You all know how quickly large locomotives develop a pound and what an expense it is to drop the wheels and correct the trouble. The fact of the matter is, the size of our locomotives has out-grown our driving box design. We have the main bearing on the top whereas the maximum pressure comes on the sides of the brass, lue to the thrust from the rod. Now how are we going to meet this?

As I see it, the most hope lies in the application of the floating bushing principle. You all know what an improvement has been made in the middle connection and back end main rod brass by the use of floating bushings. The principle of these bushings is fundamentally correct and I believe if the same principle can be applied to the driving box so that the thrust will come on different portions of the brass at different times, we will get a box which will run three or four times as long as the present design.

Lubrication will, of course, be a problem but I believe it can be solved by the pressure system. There has already been a design of floating bushing developed for engine truck boxes and its performance promises very well.

In mentioning engine trucks I wish to call your attention to the importance of this part of the locomotive. Falures due to hot engine trucks are the most common of all lubrication failures. We have been guided too much by old designs. At the present time much work is being done in the redesigning of the brasses, eliminating the slot and oil hole from the top, carrying the oil to the lower part of the brass. Attention is also being given the fact that a large part of the heat originates on the hub face. In this connection a better type of hub liner is necessary. Here again the floating principle appears applicable and is being worked out at the present time.

Bigger sand boxes are needed on large power. On some of our large power we now carry 3½ tons of sand. If the engineer has a plentiful supply of sand he can better protect his machinery.

A plea for a central testing bureau

In the case of the larger fuel saving devices the mechanical engineer is greatly in need of help. The average railroad does not have the equipment to test out these devices properly. The only place to test these devices properly is on a test plant and only one railroad

has such a plant. It is true we use dynamometer cars but the variables such as wind, weather, etc., make it almost impossible to draw entirely satisfactory conclusions, particularly when the percentage of difference is small. There is only one real solution for this condition and that is the establishment of a central testing laboratory under the jurisdiction of the A.R.A. A recommendation for such a testing bureau has been made to the Executive Committee but so far it has not seen fit to adopt it, but I sincerely hope that the day will come when we will all have the benefit of such a bureau.

From time to time the work performed by existing locomotives is being increased; this is made possible by higher boiler pressure and application of capacity increasing devices. As a result they are moving heavier trains and in most cases at a higher rate of speed. The major part of the locomotive mileage in the next few years will be made with existing locomotives, consequently the major item of importance is to make the locomotives we now have more reliable and more efficient machines. You who are continually in touch with the operation of these locomotives can be of a very great assistance in helping the mechanical engineer achieve these results. He must rely on you for first hand information as to these conditions. You should make every possible suggestion as regards changes which can be made to better locomotives. If your criticism is constructive he will certainly welcome it and you will be doing an important part in improving the design of the locomotive on your line.

A big field for future development

By John E. Muhlfeld
Consulting Engineer

Considering the term "locomotive" broadly as relating to any kind of mobile machine used for transportation on land, my observations in several countries during the past few months indicate that the steam locomotive, after about a century of commercial service, is still the premier self-contained motive power for movement of passengers for relatively long distances, and of tonnage freight for both long and short hauls, and that it also provides the most comfortable means for traveling. I predict that with the inauguration of the many possible constructive and operative improvements, it will maintain this position for several generations to come.

We have in our most modern conventional types of steam locomotives a machine that, at its best, will produce from seven to eight per cent thermal efficiency in terms of the best value in the fuel fired. In average road service this percentage will be reduced to from four to six per cent.

Thing needed to double thermal efficiency

In order to double the prevailing thermal efficiency and bring it to about 15 per cent, I will offer the following suggestions for your serious consideration:

1—Steam of from 400 to 800 lb. boiler pressure, superheated so that the total temperature will not exceed 750 deg. F.
2—Multiple or a higher rate of expansion of the higher pressure superheated steam.
3—Better distribution and utilization of the steam in the cylinders.
4—Reduction in cylinder back pressure.
5—Reduction in loss of superheat from stack.
6—Reduction in loss of steam pressure between boiler and cylinders.
7—Reduction in moisture contents in saturated steam as delivered to the superheater.
8—Improved circulation of water in the boiler.
9—Greater volume of steam space in the boiler.
10—Improved combustion of fuel.
11—Greater utilization of products of combustion for evaporation and superheating.
12—Feedwater heating with both waste steam and gases.
13—Shorter rigid wheel base.
14—Greater utilization of engine and tender total weight as adhesive weight for starting, acceleration and running and to negotiate ruling grades.
15—Reduction in dynamic augment in preference to reduction in axle loading.
16—Greater accessibility of boiler and machinery parts.
17—Reduction in number of detail parts and accessories subject to wear, failure and breakage.
18—Reduction in smoke, cinders and noise.
19—Automatic force-feed lubricators for valves, cylinders, stokers, air pump and feedwater heater.

The natural question is "How can this all be done and how much is it going to cost?" From my recent observations in Europe and what we have learned from the "Horatio Allen," a 350-lb. pressure, crosscompound locomotive, in road freight service on the Delaware & Hudson during the past two years, it is my opinion that these results can be obtained at a reasonable investment cost along the following lines:

1—Combination water and fire tube boiler which will eliminate the existing conventional crown and side sheet type of firebox and substantially increase the firebox evaporation surface.
2—Improved fire-tube superheater which will substantially reduce existing resistance to the flow of steam.
3—Combinations of one or two main high and low pressure cylinders, all placed outside of the engine frames.
4—Poppet valves and improved valve gear all disposed outside of the frames.
5—Radical change in exhaust nozzle and smokebox draft appliances, including an automatic variable nozzle.
6—Removal of dry pipe, throttle valve and superheater header outside of the boiler and smokebox.
7—Enlarged and unobstructed passages throughout the boiler particularly at the furnace end, to provide free circulation and ebullition and increased saturated steam space.
8—Self-contained equipment on the engine and tender to provide for preparation and burning of either solid or liquid fuels in suspension.
9—Production of a greater percentage of saturated steam at the furnace end of the boiler.
10—Better distribution of flow of products of combustion around and through the evaporation surfaces and as between evaporation and superheating surfaces.
11—Combination waste steam and flue gas feedwater heaters.
12—Reduced total weight of engine and driving axle load per pound of tractive force.
13—Elimination of all unnecessary leading and trailing wheels.
14—Use of high elastic limit steel castings or forgings to reduce unsprung weight in driving axles, wheel centers and main and side rods, as well as in other revolving and reciprocating parts.
15—Make the basic design of the boiler and machinery such as will provide maximum power, efficiency and economy without the use of unnecessary dead weight and complication in accessory equipment.
16—Adequate counterbalance in each driving wheel, keeping the centers of gravity of the planes of revolving and reciprocating parts as close as possible to the planes in which the counterweights revolve.

The foregoing seems like a large order, but representative European and American railway engineers have agreed that such changes can and should be made in the future American steam locomotive, which will have a life of from forty to many more years. These changes will bring its thermal efficiency up to that of the self-contained Diesel or internal combustion engine and far beyond that of the electric locomotive, at much less investment, maintenance and operating cost per unit of power developed.

It is well to remember in this comparison that the governing factors in producing efficient and economical hauling capacity in the steam locomotive is to overcome heat reduction and in the electric locomotive to prevent heat rise. Also that electric motor equipment has already reached a high state of efficiency, whereas the

possibilities of improving the efficiency of steam generation and utilization are almost unlimited.

"Horatio Allen" has proved its practicability

The "Horatio Allen" locomotive, which has been in regular road freight service on the Delaware & Hudson, between Oneonta and Mechanicsville, N. Y., during the past two years, has now made about 54,000 miles as a single-crewed and pooled engine. Nothing has developed in its road service or terminal handling that necessitates its being given other than the same attention received by other steam locomotives It has not made more mileage because of the repeated minor changes made in connection with the experimental and test work relating to the high pressure, steam distribution, multiple expansion and like factors. The boiler and the 350-lb. steam pressure have given remarkable results and another more simplified design is now under construction which will make use of 400-lb. boiler pressure and will be named the "John B. Jervis." This locomotive will be ready for service probably during November of this year.

Since the first locomotive testing plant was installed at Purdue University when I was a student there in 1891, several others have been built, those now in existence being notably at Purdue where the greatest amount of work has been done; at Altoona, on the Pennsylvania, and at the University of Illinois.

Subjects needing scientific investigation

We are sorely in need of definite scientific information relating to steam locomotive combustion, heat absorption in boiler, distribution and use of steam, reduction of cylinder back pressure, superheat, feed heating by waste steam and gases, boiler efficiency in relation to production and exhausting of steam and to intermittency of exhausts, relation of grate area to firebox volume and heating surface, the relation of fire flue to fire tube gas areas and of superheater element to fire flue areas, compounding, insulation, draft, combustion and cinder losses, furnace and flue gas temperatures, dynamic augment, and many other important factors in railway operation and maintenance. For example, water converts directly into steam at a temperature of about 700 deg. F. when under a pressure of about 3,000 lb. and steel will stand up under heavy pressures at a temperature of about 900 deg. F. We can, therefore, see the possibilities for further developments in the direction of steam temperatures and pressures.

In recently installed pulverized fuel burning central power stations, the heat in the fuel that is actually absorbed by the boiler and superheater will average 85 per cent and by the boiler, superheater and economizer 91 per cent. This performance is obtained with coal having about 12,600 B.t.u. over 2 per cent moisture, 35 per cent volatile, 51 per cent fixed carbon, and 11 per cent ash, and the CO_2 in the stack gases averages 15 per cent. In steam locomotive performance, with the best hand firing, we get a combined boiler and superheater performance of about 75 per cent and the average will run about 65 per cent.

A. R. A. needs modern testing plant

The foregoing is cited to show how much still remains to be done in steam locomotive boiler development and operation. The American Railway Association, Mechanical Division, should be provided with a centrally located modern locomotive and car testing plant which can be used by all member railroads and devoted to the scientific and unbiased research and study of the complete locomotives and cars, and of the detailed equipment, material and special appliances relating thereto. In this way correct designs and materials and the fundamental and the scientific laws governing locomotive and car operation and efficiency could be determined in a constructive, practical and economical manner. Then, by combining this information with that which can be obtained in the field with dynamometer cars on long runs and heavy grades, we can secure the fullest measure with respect to the drawbar pull and train resistance factors, in addition to the combustion and steam data which can be obtained both in the field and in the test plant.

Provided with such facilities and with unbiased facts as to the actual results of steam locomotive road operation, I have no hesitancy in saying that we could readily double the existing steam locomotive thermal efficiency and otherwise reduce the future fuel, water and other costs to the extent of hundreds of millions of dollars annually with a relatively small proportionate increase in the investment cost of the steam locomotives themselves.

Trends in locomotive development

By A. G. Trumbull
Chief mechanical engineer, Erie

The trend of development of the locomotive has been twofold—first, and most important, with respect to the boiler, and second, and of lesser importance, with respect to the engine. I place the boiler first because the principles underlying steam application have long been better understood than have those of economical generation, especially as applied to locomotives. Indeed, we are today without the basic facts upon which to design with certainty a locomotive boiler to produce most economically the maximum evaporation under varying service demands with a minimum fuel consumption. In this respect the stationary steam generation plants have long been models of scientifically efficient mechanical precision.

The most recent examples of current locomotive design have featured a relatively larger grate area than has heretofore been the accepted practice and this has naturally resulted in an increase in firebox volume which impresses me as offering the greatest opportunity still available for the economical utilization of coal in steam production.

More firebox volume

Those solid fuels having high percentages of volatile matter with which most of us are chiefly concerned, on being heated, give off the volatile portion in the form of a gas or as is commonly the case, a mixture of gas and fine particles of solid material. In order to secure combustion of the volatile gaseous portion of the fuel, it is necessary that it be mixed with a definite proportion of air heated to a high temperature; therefore a definite furnace volume is required above the grates which is the reason for the familiar difference in firebox construction between anthracite and bituminous coal burners.

All of the air required for the combustion of the volatile matter passes up through the fuel bed and as the rate of combustion per square foot of grate increases, the velocity of the air through the fuel bed must also increase, with a consequent tendency to carry small particles of the solid combustible above the fuel bed. It is possible under these circumstances to secure complete combustion both of the volatile and solid portions of the fuel, but if the furnace volume is insufficient, the gas, consisting of volatile combustible, air and fine particles of solid fuel may enter the flues where the temperature is likely to be reduced below the point at which the neces-

sary chemical union of the oxygen with other materials may take place and substantial losses thus occur in combustion efficiency.

It will be seen from these brief considerations that grate areas, furnace volume and air supply are essential factors in combustion. Moreover, in general, chemical processes are vitally influenced by the time element, those that are not hurried being likely to be most complete. In the case of the firebox, if the volume is sufficient and the grate area adequate, the velocity of the air and gases will be low enough to permit complete or nearly complete combustion with a maximum heat absorption or evaporation.

These principles have characterized the development of stationary boiler practice during the past few years, as will be observed from the accompanying table which shows the principal relations between the horsepower, per cent of normal horsepower developed, per cent of furnace volume per pound of coal burned, overall efficiency and other interesting factors indicating the influence of combustion volume upon boiler output. This table indicates that since 1905 with a hand-boiler the furnace volume per pound of coal fired has increased more than 4½ times with a stoker fired boiler and more than 7½ times with powdered fuel. The corresponding boiler ratings are 125 per cent, 275 per cent and 300 per cent respectively. It is of importance to note that this remarkable increase in capacity has been attained with an increase of more than 22 per cent in evaporation per pound of coal having a fixed heating value. This very extraordinary development in steam generation would appear to indicate that there are yet undeveloped possibilities in locomotive boiler capacities to be attained through the use of large grate areas combined with as high a ratio of furnace volume to grate area as is consistent with limiting clearance dimensions.

A locomotive of this description must of necessity have its firebox carried upon a trailing truck, thus materially increasing the non-adhesive weight and adding to the cost of maintenance and depreciation as well as to the original cost. However, these disadvantages should be more than offset by increased boiler output, the importance of which needs no emphasis. The hauling capacity of a locomotive at any speed is dependent on the steaming capacity of the boiler. Consequently, if the boiler can be proportioned to produce a greater volume of steam with a possibility of improved furnace economy, a locomotive of given proportions will either haul more cars or it will haul the same number of cars at increased speed, either of which will increase the available ton-miles per hour capacity of the locomotive, and that means reduced transportation cost.

Comparative proportions recent experimental and other locomotives

Engine	Type	Boiler press.	Tractive force	Evap. heating surf., sq. ft.	Grate area, sq. ft.	Ratio heating surf. to grate area	Firebox volume cu. ft.	Ratio firebox volume to grate area	Factor of adhesion
Horatio Allen	0-8-0 comp.	350	70,300	3,200	71.4	44.81	575	8.05	{3.25-S / 4.25-C}
Baldwin 60,000	4-10-2 comp.	350	82,500	5,192	82.56	62.89	735	8.9	4.10-C
Lima No. 1	2-8-4 sim.	240	69,400	5,110	100	51.1	515	5.15	3.58
N. Y. C. 8,000	2-8-2 sim.	210	66,700	3,676	70	52.5	372	5.3	3.72
Penna. I-1S	2-10-0 sim.	250	90,000	3,944	70	56.3	385	5.5	3.8

Higher boiler pressures are coming

The possibility of substantially increased economy through higher boiler pressure is a fundamental fact, the improvement being due to differences in the temperature of the steam. We do not ordinarily consider that a steam engine is essentially a means for the conversion of heat into mechanical force, but in an analysis of economies resulting from the use of steam it is necessary to proceed with heat units as a basis. The increase in efficiency is measured by the difference in the heat content of the steam at admission and the heat content at exhaust after expansion has occurred in the cylinder. That being so, if the initial pressure is increased through the application of additional heat, a relative increase in efficiency must result.

It is an interesting speculation as to what this trend may reach in the immediate future and we may pause to give it a moment's consideration. By 1935, if the present tendency continues, we shall have locomotives quite generally carrying 325 lb. to 350 lb. pressure. In view of the probable influence produced by the introduction of the water tube boiler, this roes not appear to be an unreasonable conclusion. On the contrary, there are some forward looking locomotive designers who predict that we shall ultimately reach pressures as high as 650 lb., but I am too much handicapped by the limitations arising out of practical experience to share so venturesome an opinion. In fact, such pressures appear highly improbable because of considerations both theoretical and practical. While there is an advantage to be gained through higher steam pressures than are now usually employed, the increased economy becomes progressively less as the pressure increases and at very high pressures the saving cannot be realized through simple expansion. Then, too, the difficulties of maintenance that may be imagined with excessively high pressures, even with a well designed water tube boiler, are too great to warrant the conclusion that such pressures are of practical application.

Trend of furnace development in stationary boiler service, central power plants

Year	Method of Firing	Size of boiler units in general use, hp.	Per cent of furn. vol. per lb. of coal compared with 1905	Per cent rating representing good practice	Per cent increase over 1905	Lb. coal per lb. water evaporated	Per cent decrease under 1905
1905	Hand	450	100	125	..	.1227	..
1910	Stoker	450	180.5	175	40	.1165	5
1915	Stoker	670	216	225	80	.1104	10
1920	Stoker	830	434	225	80	.1068	13
1925	Stoker	1,450	455	275	120	.1003	18
1925	Pulv. fuel	1,450	736	300	140	.0974	21

Compounding has a future

It is unfortunate, perhaps, that our experience with compound locomotives antedated the present tendency

to higher boiler pressures because the difficulties in maintenance and the operating problems they introduced are likely to retard the reintroduction of the compound, notwithstanding its economical possibilities. The compound for general service was originally introduced mainly for the purpose of preventing cylinder condensation, but with the successful development of the superheater this advantage disappeared and with it the train of difficulties still fresh of memory. However, the gain through a greater range in initial and exhaust pressures cannot be realized through the higher boiler pressures without using the compound principle, because in a single cylinder at long cutoffs, it is impossible to expand the steam down to the required exhaust pressure. This fact accounts for the use of the cross-compound design of the Horatio Allen. In the case of the Baldwin engine, however, the compound feature was probably introduced to secure the advantage of the three-cylinder arrangement and at the same time obtain the economy resulting from decreased heat losses in the cylinder walls produced by expanding the steam in two stages, that is in a high pressure and two low pressure cylinders.

In addition to the reduced cost of maintenance of this type of boiler which has been said to approximate 50 per cent, there has been great expectancy of relatively increased steaming capacity. The use in firebox construction of tubes and cylindrical drums in place of flat stayed surfaces, makes it possible to reduce the thickness of the material and this ought to favor heat transfer and consequently increase the evaporation per square foot of heating surface. Unfortunately there are no capacity tests of this type of boiler available; those which have been made were on relatively the same basis of boiler demand and show no increase in evaporation per unit of heating surface over boilers of the usual construction.

In addition to the anticipated gain through increased heat transfer, there is an undeniable advantage in improved circulation and also in the greater firebox volume attainable within the prescribed clearance limitations. These factors should produce a marked influence on the capacity and serviceability of the boiler.

The booster and limited cutoff as traction increasers

Now, with a boiler of any type designed to afford a maximum firebox volume, a considerable part of the weight will be transferred from the drivers at the expense of adhesion and right here a very important difference of opinion develops between locomotive designers. I believe this will disappear with the completion of the investigation of the service rendered and the economy developed by the experimental locomotives now in service. The situation is very well illustrated on the chart of comparisons between the Lima and Baldwin engines and the Horatio Allen. It will be observed that in the case of the Lima engine, the calculated ratio of adhesion is but 3.58, which is admittedly too low unless some compensating feature is introduced. This problem is met in two ways—first by the application of a booster to the trailer truck and second by the use of the limited compensated cutoff feature. Both aid materially in the production of maximum hauling capacity at slow speeds and the limited cutoff also greatly increases the cylinder horsepower at speeds.

It should be observed that with a fixed cutoff as short as 50 per cent, when the usual type of valve design is employed, at starting or at extremely slow speeds the main steam ports will not open and to meet this condition additional or so-called compensating ports have been introduced. The cutoff may be fixed without the use of compensation ports, but not at as high a figure as 50 per cent. With the ordinary type of valve gears, a fixed cutoff of 70 to 75 per cent can be secured by increasing the steam lap of the valve and by changing the ratio of the lap and lead lever to correspond with the increased valve lap. Incidentally, this measure affords a desirable means of improvement in existing locomotives, especially as it can be so readily accomplished.

Automatic cutoff control

The next feature of interest and value in locomotive operation contributing to increased efficiency and economy is cutoff control by means of back pressure which may be either manual or automatic. It has long been known that for each class of locomotive—and a distinction is here made between type and class—there is a point of cutoff for each speed that will produce a maximum hauling capacity. An attempt was made some years ago to apply this principle in practice by furnishing a card to enginemen on which the necessary information was given in table form but the plan failed of general adoption because it imposed too great a burden upon an already very busy engineman. The use of back pressure as a means of establishing maximum hauling capacity is, however, of comparatively recent application.

Other conditions being the same, back pressure varies directly with the admission pressure, cutoff and speed and for each class of locomotive there is a definite back pressure which if maintained at a constant figure will produce the maximum mean effective pressure with a cutoff proportional to the speed of operation. This back pressure is easy of determination by experiment and the locomotive may then be operated accordingly with every assurance that it is producing maximum power. Of course, the back pressure constant is correct only for the boiler pressure at which it is established which should be the normal one. The most general method of regulation is manual corresponding to the indications of a special back pressure gauge, but a mechanical control has been devised which if successfully developed will insure the nicety of regulation difficult of attainment where dependence must be placed upon the necessary constant manual manipulation.

From the foregoing considerations it seems reasonable to conclude that the high duty locomotive of today should have the following characteristics:

1—A boiler of the conventional type with considerably larger firebox volume than has been commonly used.

2—A steam pressure of 225 lb. to 250 lb.

3—A fixed maximum cutoff.

4—Means of increasing the hauling capacity at starting when it can be advantageously employed, which would naturally take the form of a booster applied where advantage may be taken of the maximum available non-adhesive weight.

5—Means to permit operation of the locomotive with a predetermined back pressure.

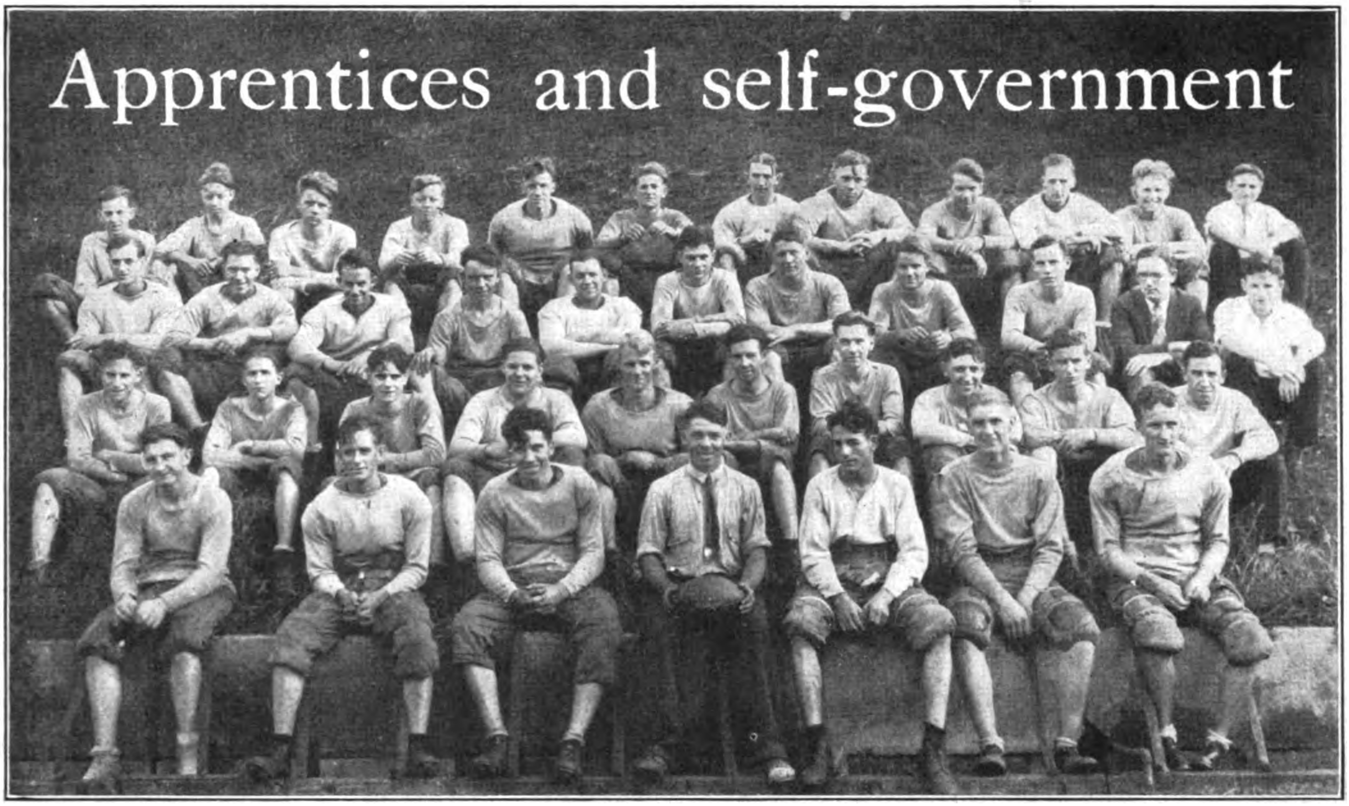
As to the future, it would appear that logical development may be expected to proceed along the following lines:

1—The extended use of water tube boilers, still utilizing the large firebox volume, and in the early stages, employing steam pressures up to 250 lb. per sq. in.

2—Increases in steam pressures up to 350 lb. per sq. in. as experience may dictate.

3—An extension of the use of compound engines to secure the advantage of the higher pressures, such engines being of the three and four cylinder type.

To those who regard these predictions as visionary it may be well to suggest that out of the misty fabric of the dreamer's visions, the substance has been fashioned of all the wonders that are now the everyday accompaniment of our material existence.



The 1926 apprentice football squad

CHARLES F. BAILEY, engineering director of the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., presented an unusual paper on apprentice training at the Old Dominion Meeting of the American Society of Mechanical Engineers at Richmond, Va., in September. Several of the practices which have given excellent results at the Newport News plant will undoubtedly appeal to those railways which have been interested in improved apprentice training methods. This is particularly true of the self-government feature. The following extracts are from Mr. Bailey's paper.

The apprentices are in charge of instructors in the shops who assign their work and teach them the best ways to execute it. The boys in the pattern and the joiner shops are grouped largely by themselves, although in the other shops and aboard ships they are more scattered, but under instructors.

School work

For a period of approximately nine months yearly, during the second to the seventh terms (each term is six months) inclusive, sessions are held for study in the class rooms, thus intimately interweaving scholarship with shop work. Each apprentice attends two half-days each week during the regular working hours with pay. Teachers under the supervisor of apprentices conduct these classes. Monthly reports of the school room work and the shop work are made, rating each apprentice on his trade ability under the headings, *workmanship, accuracy, application, aptitude* and *skill*. Character is rated under the headings *interest, initiative, judgment, conduct* and *moral sense*. School work and shop work are rated by percentages. To a certain extent the apprentice teaching is aided under the provisions of the Smith-Hughes Act.

The practice of conducting the school during working hours is found, in the case of trade apprentices, to give the best results. The control is better and the co-ordination between shop and school work is closer than when the studies are given outside of working hours. With advanced students, where the opportunity is presented to attend evening technical classes, the problem is quite different. It is found, however, that some of the more ambitious and brighter apprentices will take evening classes in addition to their regular shop training and class work.

An artistic certificate is presented to the apprentice on the satisfactory completion of his course; a cash bonus of $100 is also given.

Promoting interest

Incentives are provided, such as distinguishing the benches by numbering to indicate excellent performance; posting the marks for public notice; presenting minor prizes in the form of tools or small gold pieces; citation or promotion for special effort or exceptional performance; the granting of scholarships in evening schools or in correspondence courses; and, as the highest reward, a scholarship allowing contingent expenses in some higher institution of learning for a period of one, two or more years. The incentives are so offered as to create a lively spirit of competition and it is intended to make them sufficiently numerous so as to encourage the slower, but well-meaning, boys.

Extraneous activities

Athletics constitute one of the principal activities outside of the working hours. The spirit of sport is encouraged by the management and particularly by the employment manager and the supervisor of apprentices, who co-operate and co-ordinate in all matters concerning the apprentices. The boys play the smaller colleges and the freshmen teams of some of the larger schools. Their

spirit of honor, fair play and manliness make them popular contestants. While in training they willingly forego smoking, with other restrictions, in order to better fit themselves to meet their contestants.. This also applies to the boys in other activities, such as the band organization, where semi-weekly practice is maintained throughout the year, regardless of weather and handicaps.

The apprentices have fitted up a very attractive club room which is open for meetings of committees, the council or for interviews during the day. Each evening the club is open, the boys taking turns in assuming charge of the premises.

It is not intended to convey the idea that obstacles and difficulties are not encountered—there are many of them. Some of these have been satisfactorily solved by the boys themselves. As an example, a few weeks ago a group of six of the more influential apprentices desired to take a brief leadership course at Blue Ridge, North Carolina. They were assisted in this by the company, who paid a portion of their expenses. When they left for this training the supervisor propounded several questions of a hypothetical nature bearing on apprentice problems. These were carefully considered and worked out with such reasonable and practical answers that a number of them have already been put into effect with gratifying results. Other problems proposed by this group and now receiving attention are as follows: shop organization and discipline, improvement of social facilities, promotion of alumni interest, reception for probationers, review of qualifications of applicants, development of graduation exercises, publication of apprentice paper and year book.

Thrift is encouraged and practiced through an apprentice banking organization.

Apprentice band ready for rehearsal

Self-government

The government of the apprentice body is administered under a constitution adopted by the Apprentice Association which provides for self-government. The supreme authority rests in an honor council, composed of ten representatives from the various departments. The members are elected by and from the apprentices, and serve during the remainder of their apprenticeship or during good behavior. Election is by secret ballot. Meetings are held upon the call of the president or the supervisor of apprentices.

The council makes and executes all the rules and regulations governing the apprentices and acts as representative of the body. It settles grievances or complaints, provides for election and interprets the constitution and by-laws. The employment manager and the supervisor of apprentices are ex-officio members, in an advisory capacity, but without the right to vote. After election to the council the officers are duly installed by subscribing to a pledge administered by the supervisor of apprentices. This reads as follows: "I do solemnly promise to support the constitution of the apprentice body, and to perform the duties of my office to the best of my knowledge and ability."

All members of the apprentice council also take the following pledge: "I do solemnly promise to perform my duty to the best of my ability and if possible to the satisfaction of the apprentice body."

This form of government has proven most satisfactory and is considered one of the outstanding influences for good.

Not long ago three members of the honor council were designated on a mission to represent the apprentice body and failed to discharge their duty. This was brought to the attention of the honor council which immediately convened and after a searching inquiry demanded their resignations from the council which were accordingly given. This incident is conspicuous because of the prominence of the men involved.

Some months ago three apprentices outside of working hours committed a serious offense. These men were brought before the honor council and recommended to the supervisor of apprentices for dismissal from apprenticeship and employment; this was accordingly done. After some months, one of the men confessed to his error and asked to be taken back. This request was considered by the council, which recommended that the boy be reinstated on probation, and this was done.

The young man continued with his apprenticeship under these conditions and finished the course. Prior to his indiscretion he had won in athletics, due to his spirit and sportsmanship, the apprentice letter "A." This letter, which had been recalled on his dismissal, was not returned when he was taken back on probation. Upon completion of his course a mass meeting of the entire apprentice body was called for the purpose of distributing letters and honors which had been earned by other apprentices in the recent contests. At this meeting there were also present a number of the yard officials. At the last, after the honors to the other apprentices had been

awarded, this young man was called to the front and his letter returned to him amid the applause of all present. He is still a faithful employee of the company, but he has not forgotten the lesson which was administered by the honor council while he was an apprentice.

Results

We can hardly over-rate the importance to the youth of the formation of right habits during his apprenticeship. The governing body and the honor council exert a powerful control over their associates in this respect. With apprentice groups who are keen and alive to their advantages; who are deeply interested in their trades; who have agreeable associates with like ambitions and high ideals of character and deportment; who have inspiring traditions of the past, and who realize that they must uphold and contribute to these traditions, it may reasonably be assumed that a good proportion of such men will be in sympathy with and help to promote all endeavors to increase efficiency and production.

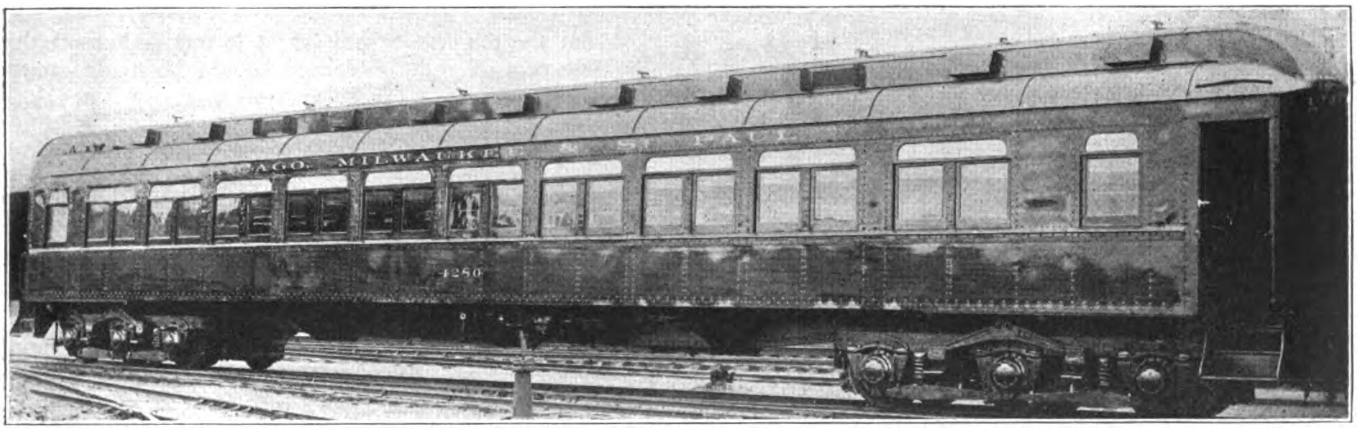
Such ideals may, to a large extent, be implanted in the minds of a goodly number of the boys by the supervisor of apprentices, the instructors in the school and those who teach them in the shops. This influence is constantly exerted by the honor council or governing body. In the matter of discipline it is usually more severe in their requirements than the instructors. If bad habits are corrected in early life a useful man will develop who will be a credit to the community.

Annually, after the football season has closed, the company gives a banquet to the entire body of apprentices. These functions are held in the high school building. The city school officials, representatives of the press, a few prominent guests, and the officials, superintendents and foremen of the company are invited. The occasion is enlivened with music by the apprentice band, snappy speeches, to which the boys also contribute, and apprentice yells occasionally sandwiched in. The enthusiasm and spirit which prevail on these occasions continue long thereafter.

Roller bearing equipment for the C. M. & St. P.

Tests extending over two-year period demonstrates practicability—127 passenger cars equipped

As a result of tests conducted over a period of two years, demonstrating the practicability of roller bearings of several types and their advantages over plain bearings, the Chicago, Milwaukee & St. Paul recently decided to make an extensive installation of roller bearing-equipped passenger trains. Sixty-four new Pullman cars and 63 cars of St. Paul ownership were accordingly ordered fitted with roller bearings. While both Hyatt and S.K.F. bearings were tested with satisfactory results, the order for roller bearings for this equipment was placed with the Timken Roller Bearing Company, Canton, Ohio.



C. M. & St. P. all-steel passenger coach No. 4280 equipped with roller bearings

The experience of the St. Paul in testing roller bearings as compared with plain bearings was outlined recently by L. K. Sillcox, general superintendent of motive power in a paper read at the Chicago, Milwaukee & St. Paul annual car department staff meeting, held at Milwaukee, Wis., September 20, 21, and 22. An abstract of this paper appears below:

Mr. Sillcox's paper

Among the advantages which test experience on the Chicago, Milwaukee and St. Paul indicates may be expected of roller bearings as applied to passenger car equipment are reduced train resistance, practical elimination of rough handling in starting long trains, easier riding equipment, less chance of hot boxes, ample warning when defects develop, fewer slid flat wheels and a saving in lubricants. Another practical consideration is the possible elimination of different engine ratings for summer and winter where air temperatures have a wide variation.

While roller bearings have been discussed and considered for steam railway service during a period of

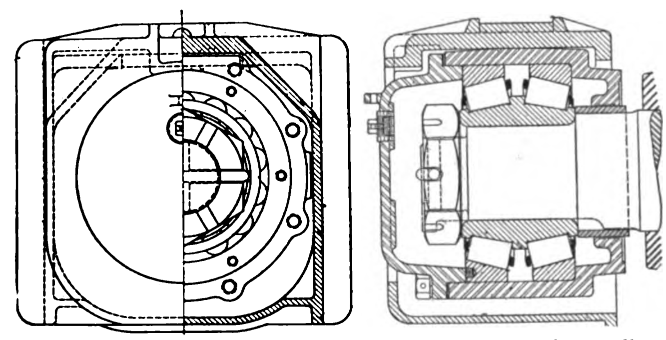
almost 25 years, the missing quality has always been that of durability, and designers of such bearings in their efforts to produce something suitable apparently erred on the side of giving the mechanics of the subject too much attention. They seemed to be interested chiefly in obtaining large contact areas, and in their endeavor along these lines, unfortunately neglected many other essentials, which were necessary in the development of this heavy type of bearing.

Eventually, it was realized that it was not sufficient to state simply that a bearing dealt with so many pounds load at a certain speed. The fatigue resisting properties and ability of the bearing to absorb and direct elements of side thrust under very difficult conditions of load and speed, needed consideration as well. Where the loads were high, but the speed low, the problem could always be solved by means of a ball-type bearing; but such bearings would have to be of dimensions quite impracticable in many cases, and necessitated redesign of truck frames and associated parts in order to accommodate the new construction. This fact, together with the higher cost of the bearing itself, presented a problem which has until recently appeared insurmountable from a financial standpoint.

Roller bearing developed for standard truck design

For this reason months were spent on the Chicago, Milwaukee & St. Paul endeavoring to develop a roller bearing which would take our standard type truck construction. This was worked out by engineers of S.K.F. Industries, Inc., New York, the final result being an assembly as illustrated in the photograph and one of the drawings. It will be quickly recognized that a standard cast steel truck frame was used and the only change made was that of applying straight equalizers rather than the curved ones, as in the past.

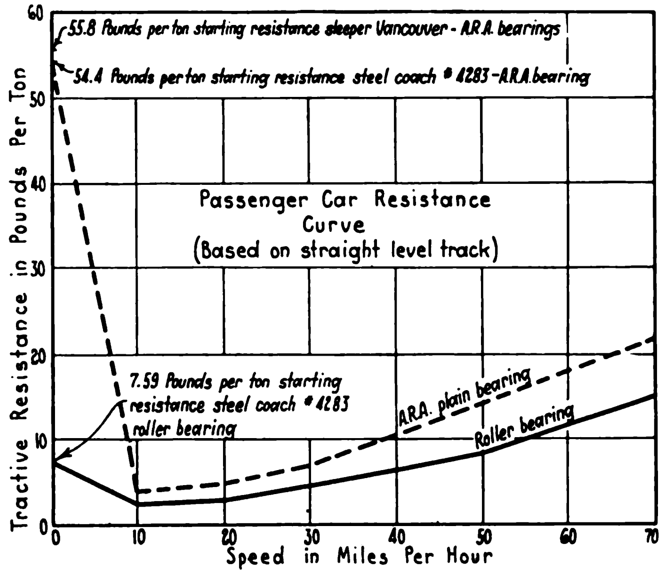
It will be observed that in the design of the cast steel pedestals, the pedestal legs were shortened to accommodate the new type box, and made considerably stiffer to eliminate the necessity of using a tie bar between them, sufficient rigidity being obtained to take care of the longitudinal thrust to which they are subjected. The method of applying the journal load through the straight equalizer and below the center line on the journal box, serves to keep the box in suitable alignment through the pendulum action of the load. The journal box is of cast steel, and since it is subjected both to tensile and torsional stresses, it has its heavy section around the load-carrying surface at the top, and stiffening ribs both at the top and around the bottom stirrup which carries the equalizer. The outer race of the bearing is in contact with the crown of the box through an arc of 150 deg. A forged shoe is dropped in the bottom of the stirrup to center the equalizer properly and secure it against motion longitudinally. A safety hanger is provided between the equalizer bar and the pedestal. Manganese steel pedestal liners are employed.



Four-motion journal box (pedestal type) with Timken roller bearing fitted to a 5-in. by 9-in. journal

A design using bearings made by the Hyatt Roller Bearing Company, Newark, N. J., also illustrated in a drawing, has been developed and is operating under Coach 4283. The third drawing shows the design of a four-motion journal box with Timken roller bearings, developed and adopted for use on the equipment just ordered.

From these drawings, a good idea may be gained of the types of bearings discussed. Both the S.K.F. and Timken bearings employ rollers having a maximum pressure on the outside, thus forcing the oil toward the center and assisting constant lubrication. The Hyatt bearing has a plain roller, non-opposing and thus necessitates an end thrust washer to take the lateral strain.



Comparative resistance of plain and roller bearings

Vital factors in roller bearing design for railroad equipment

From the experience gained, it is our judgment that the selection of roller bearings should be made on the following basis:

1—Minimum friction.
2—Ability to deal with both thrust and radial loads.
3—Ability to deal with thrust load in one direction.
4—Ability to operate successfully for at least 1,000 miles after becoming initially defective, in order to allow a car to be brought to a terminal.
5—Ability to operate a minimum of 600,000 miles without failure of parts, wreck damage excepted.
6—The unit should be self-contained, with minimum number of loose parts, and should be non-adjustable.
7—The unit should be capable of quick inspection.
8—The unit should have the feature of self-alignment.

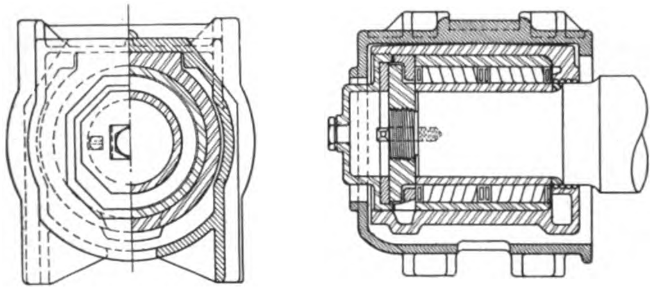
The ideal lubrication for an anti-friction bearing is a constantly circulating oil in an ample, but not too ample, volume and with only slight pressure.

Five main difficulties lie in the way of oil lubrication. Heat is generated by the churning of the oil at speeds as low as 300-400 r.p.m. (32-43 m.p.h.) unless an overflow is provided to maintain a proper level. This churning and heating increases proportionately with the depth of the oil and the rate of speed. Oil, being a liquid, is hard to retain in a housing. This is especially true because under the churning action of the moving

rollers the oil is vaporized and is dissipated to a certain degree. Owing to vaporization and other factors, oil requires renewal every six months or more. When axles are not revolving, force of gravity draws the oil to the bottom of the housing, leaving the bearing dry and exposed to rust; filling housings full enough to cover the rollers at all times results in the above-mentioned churning and heating.

Oil is more expensive than grease

However proper oil lubrication might be, it is almost impossible to attain minimum rates of expense under the average service conditions. As a result, grease is generally recommended for use where possible, at all speeds and temperatures and for all sizes of bearings. This does not mean that on some applications oil will not give satisfactory service, but that a proper quality and grade of grease on these applications should give equal, if not better, service with less trouble.



Hyatt roller bearing applied to a 5-in. by 9-in. car journal

This recommendation is based on the following points:

1—Grease of the proper consistency does not work out of the housing.
2—Enclosure design is simplified.
3—Grease applied with a modern type of gun is kept perfectly clean.
4—Grease does not need as frequent renewals.
5—Grease does not sink to the bottom of the closure when the bearing is idle.
6—Suitable greases should be easy to obtain.
7—Since grease tends to fill the space between shaft and housing, it assists materially in keeping out dirt.
8—Under the high speeds the rise in bearing temperature is less than with oil.

The essential properties of a suitable roller bearing grease are: (a) Consistency a little stiffer than vaseline (this is important, as a grease of this consistency is stiff enough not to churn at high speeds, yet soft enough not to dry); (b) no abrasive or body-giving matter, such as talc, graphite or pumice; (c) mineral base—not vegetable or animal.

For a range in speeds of 300 to 840 r.p.m. (32-90 m.p.h.) a grease renewal once a year is said to be ample. Under any conditions the most frequent renewal is every six months.

At the time of renewal the housing should be filled up until some of the old grease works out which can be wiped off. This is also a good time to note the quality of the grease last used and to see whether it has hardened. The tendency of grease to dry out is what really determines the frequency of lubrication.

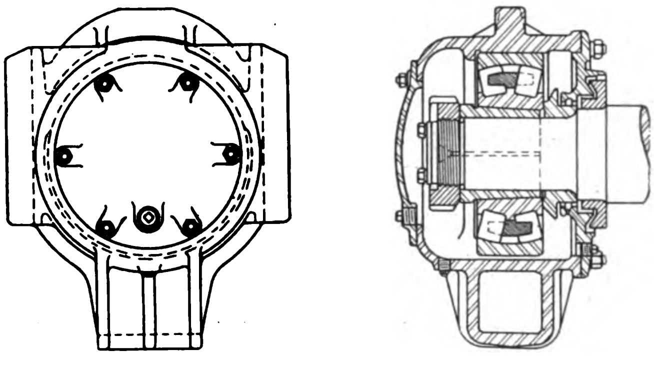
Train resistances compared

The best information which we have covering a comparison of resistances of cars equipped both with roller and plain bearings is shown in one of the charts. Our tests indicate that with steel sleepers the starting resistance may be as high as 55.8 lb. per ton; for steel coaches 54.4 lb. per ton; while under the same conditions, at the same time, resistance for steel coaches fitted with roller bearings was 7.59 lb. per ton. Under these circumstances it is possible to require in starting the Pioneer Limited, 15 cars, an effort from the locomotive of 67,200 lb. for equipment as fitted with plain bearings, as against 9,120 lb. required under these circumstances for equipment fitted with roller bearings—or in the ratio of approximately 7 to 1.

From available information, it is clear that the greater the weight per coach, the lower will be the running resistance per ton and, consequently, the greater the proportional advantage of anti-friction bearings. It also seems clear that the lower the speed, the greater the advantage to be obtained with roller bearings. The chart referred to seems to bear out this point. Drifting results obtained with plain and roller bearings are illustrated in a second chart.

Granting the reduction in starting resistance that any good anti-friction bearing will make possible, the question then becomes, in my opinion, one of life and cost. The utilization of the reduction in starting effort ought to bring about an entire change in motive power economics, but this will be a slow development with a good deal of resistance to be overcome. Those who have used roller bearings most extensively have been so satisfied with the practical results that they have thus far not been disposed to attempt to compare train resistance data through such elaborate tests as would be necessary. Therefore, they have only sought to confirm the known starting economy of roller bearings.

One of the principal difficulties encountered in attempting to evaluate the decrease in train resistance resulting from the use of roller bearings, is the lack of a definite standard for comparison in the form of data representative of standard friction bearing equipment. There is no question but that the variation in the friction of the plain journal bearing is an important factor and tests have been made to show the effect of journal temperature on train resistance. Whatever figures are available make it apparent that the actual train resistance of plain bearing equipment is very indefinite except in terms of general averages interpreted as representative of normal conditions. On the other hand, our experience with anti-friction bearings has shown that the friction of the bearing is constant over a wide range of speed and temperature conditions.



Roller bearing car journal design using S. K. F. bearings on 5-in. by 9-in. journal

The inherent characteristics of the two types of bearings justify certain inferences. It is known that the efficiency of the plain bearing is determined by the factors that control the establishment of the oil film. These include both temperature and speed, which are

obviously variable in train operation, and also unit pressures which will vary with the type of equipment. The resistance of the roller bearing is practically independent of temperature and speed through such range as is experienced in train operation. An analysis of exhaustive tests of plain bearings which are comparable with those employed on car journals, indicates that only under most favorable conditions will the friction in a standard plain bearing compare favorably with that uniformly experienced with the roller journal bearing. Practical limitations preclude the normal operation of plain bearings under those favorable conditions, since the low viscosity of oil required does not provide a sufficient margin against sudden incidental effects, which would lead to a further decrease in viscosity.

Brake action on roller bearing car studied

The effect of roller bearings on brake action was studied recently; two coaches as nearly identical as possible in weight, brake equipment and truck construction, except that one had roller and the other plain brass bearings, were tested at Western Avenue, Chicago. Eight tests in all were made, the cars being stopped from various speeds with several different service and emergency brake applications.

It was observed that the wheels on the coach with roller bearings did not slide at any stop, while the rear wheels of the trucks on the coach with brass bearings slid at every stop made with an emergency application, the cause of the rear wheels sliding being due to the transfer of weight during the quick stop. This transfer of weight did not seem to affect the coach with roller bearings. The coach with the roller bearings ran a slightly greater distance, while subjected to the same applied brake force, than the other car, but the difference was so small as to have no noticeable effect in controling the train.

In connection with roller bearing applications, the importance of providing suitable hand brakes, buffers and draft gears (no preliminary spring action being required as at present to aid in starting trains), must not be overlooked. The advantages to be gained from drifting roller bearing-equipped trains are readily apparent and should be studied in service with a view to relieving the engine and consequently the coal pile to the greatest possible extent.

Filing of drawings and drafting room correspondence

Multiplicity of handlers, shifting of employees and unusual storage hazards important factors

By Warren Ichler

ANY discussion of a matter so subject to individual preferences, space limitations, usages, hazards, etc., as is a system of storing mechanical department records, will have to be general in character, rather than specific recommendations. A slight consideration of the subject will show why this is necessary. Records are valuable in direct ratio to their availability to *all* interested parties—in many respects the availability is an even more important factor than the completeness of the record.

It is obvious that, to be readily available, these records —historical data, if one gives them their real title— will have to be kept in such locations and in such manner as to be independent as far as possible of such disturbing factors as a multiplicity of handlers, a shifting personnel and extraordinary storage hazards. With these major requirements in mind, consideration of specific systems and their peculiarities can be attempted.

The filing of mechanical drawings presents some unique problems in record-keeping, in that it is governed more largely by bulk than is the keeping of correspondence or statistics which do not involve drawings or other large sheets of paper.

The two primary subdivisions of drawing lists

Nowadays practically every railroad mechanical drafting office subdivides its lists of drawings primarily by sizes and secondarily by subject matter, or else reverses the order of importance of these two subdivisions while retaining the same general scheme.

In order to adapt the sizes of blue-prints to correspondence, the dimensions of drawings most in vogue at present are the dimensions of ordinary bond paper (8½ in. by 11 in. or 8½ in. by 12 in. letter size), or multiples of these sizes. Thus a list of drawing sizes could be prepared and standardized in practice as follows:

No. 1 size—8½	in. by 12	in.
No. 2 size—12	in. by 17	in.
No. 3 size—17	in. by 24	in.
No. 4 size—17	in. by 36	in.
No. 5 size—17	in. by 48	in.
No. 6 size—24	in. by 51	in.
No. 7 size—34	in. by 60	in.

Larger sizes, if desirable, could be further multiples of the same basic figures. Prints of the sizes given will, of course, fold readily to letter-head size and pack easily into the large envelopes provided for unfolded correspondence files. Occasionally for convenience, fold lines are indicated on the margins of drawings and prints as in the accompanying illustration.

This index of sizes furnishes a valuable reference guide and in some cases the only reference guide to the location of the drawing in the files. That is, in a list of drawings not exceeding, say 2,000 sheets, it is possible to place all of the No. 1 size in one drawer or other compartment; all of the No. 2 size in another compartment, and so on. Under this system the individual drawings could be catalogued without regard to subject primarily, and merely numbered serially thus: 1-211; 2-212, etc., in which the first number indicates the size of the drawing and the second number its serial position in

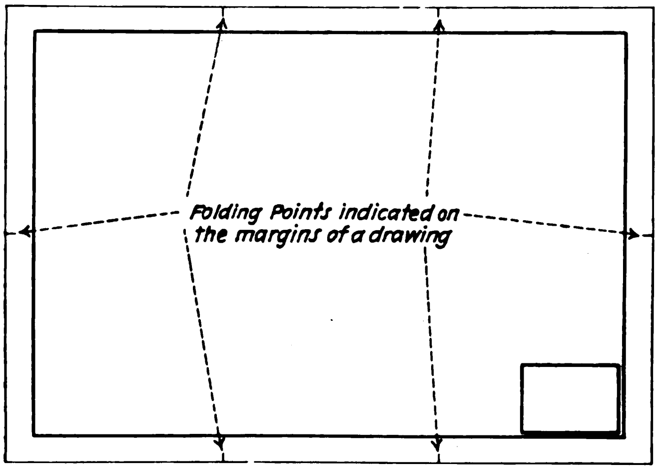
the catalogue. Obviously, this system is applicable to small, fixed files only, but with many of the smaller carriers where files of builders' prints of one or two classes of engines and cars are maintained, this method of filing would be sufficiently flexible since a recollection or pre-knowledge of the probable size of the drawing would probably locate its compartment position without reference to the catalogue cross index of subject matter. Of course for completeness the ledger or catalogue of the entire file would contain the subject of the drawing but the subject would be subordinated to the size and serial numbers.

Thus, a typical entry in the ledger would read

Drawing No.	Title or subject
1-211	Reverse link—engines 1-21
7-212	Boiler—engines 32-33
3-213	Erecting valve gear—engines 1-21

and it is evident that from the standpoint of bulk alone, this system would be ideal since it can be contained in a maximum of seven or eight compartments and would probably be even more severely condensed by combining in one larger drawer several of the smaller sizes separated only by thin partition strips.

But as railroads expand and new developments occur, records pile up and the simplicity and compactness of the storage system just described have to be sacrificed to secure better availability of the records. It is not uncommon on a Class I railroad operating some 800 locomotives and from 30,000 to 40,000 freight cars to find files of mechanical drawings totaling 25,000 to 40,000 separate sheets all of which are live drawings; that is, in more or less active demand.



One method of folding large drawings

In such a case it is imperative to have at least two primary subdivisions of drawings and this is most easily effected by a combination of the sizing system just described and of subject matter of drawings. The storage problem now has injected into it the element of space limitations and since it is physically impossible to provide room for each minor subdivision of the various parts of locomotives and cars we have to effect a grouping into general classes of the various related parts of locomotives and cars in order to avoid an intolerable unwieldiness in filing cabinets.

The general subdivision classifications

At this point enters the personal element. How many general subject classifications on a locomotive shall we have? Is it advisable to group with boiler drawings the boiler appurtenances such as injectors, check valves, grates, and ash-pans? Such questions could be multiplied endlessly and any reasonable number of part classifications adopted; but any such system is bound to be purely arbitrary in certain details at least, and not universally applicable.

It is suggested that as a basis for this classification and cataloguing of part drawings, the Locomotive Dictionary's chapter headings offer some valuable suggestions. It is not recommended here that the various groups should be so severely condensed into great group families, as is done in that volume; but at least we have a guide toward a more or less common practice in relegating frames and spring-rigging; cabs and cab mountings; valves and valve-gears, etc., to common classes or groupings.

Now as to the distinguishing marks for these groups of drawings. For the sake of variety and for the avoidance of title confusion, it would seem best to turn to the alphabet for markings for the various classes. Under this combination of number-letter notation of headings, 26 groupings are provided for, and in most cases this should be ample for all preferences and needs of the drafting room.

Of course we have to retain both in fact and in record the separation and notation by size and serial number so that our titles and numbers as entered in the catalogue take on some such appearance as this:

Drawing No.	Title or subject
1-A-211	Reverse link—Engines 1-21
7-E-212	Boiler—Engines—32-33
3-A-213	Erecting valve gear—Engines 1-21

in which *A* denotes the classification assigned to valve gear parts; and *E* the identification symbol of boiler drawings. Then by marking file compartments 1-A; 3-B, etc., it is evident that this comparatively simple system will obviate a lot of tedious searching when once the classification-letter significance is understood and remembered by its users.

A variation of the above indexing method can be applied where not more than 26 classes of engines or cars are to be covered by the system. In that case the part classification is discarded and the letters or symbols each bear reference to a certain class or group of locomotives. This third method of filing would remove the factor of arbitrary classification of units or parts from the filing scheme but would retain all the bulkiness of the former system, since as many filing compartments as the number of drawing sizes would have to be provided for each class of locomotives and each class of cars.

Then, too, this third system is not truly definitive since a 3-a drawing may as easily refer to a car draft gear as to a locomotive valve gear part except for the following serial number. Since the serial number of a drawing is not really an identification tag, except to a very limited extent, there would have to be a complete separation of car and locomotive drawings for rapid reference work unless the filing was under constant control of one person, who could manage a separation of the car and locomotive drawings in each compartment by means of cardboard separators or other devices.

A rather effective combination of the two systems just outlined is that which confines locomotive drawing classifications to the letters *A* to *L*, say, and frees the remaining letters *M* to *X* for use as designators of drawings covering freight and passenger cars or even cars and shop machinery and tools. Of course this again brings to the fore the matter of arbitrary classification of unit parts; hence making a personal rather than an impersonal system, but it is fairly moderate in its space demands and reasonably simple in its handling.

Along with the basic rules governing the initiating of any system for reference work, there must be considered the special variations covering those things in process of

development or retirement; that is, in a transition stage. For example, new and heavier frames are being applied to a certain class of locomotives; but the retirement of the old frames is being done so slowly that many parts related to the old frames have to be supplied until the betterment is completed in its entirety. It will be seen that this will involve a duplication of many drawings except in the case of the very simplest changes and since it is obviously impossible to provide individual filing space for all of the records of even one project of major importance, they will have to be filed in the proper existing spaces and receive some distinguishing mark or notation that will effectively protect the user from error.

This is most easily done, in the majority of cases, by suffixing a mark or letter or number to the serial number of the drawing to call attention to the date of issue or the precedence of the drawing over similar drawings of the same subject. A typical index page would show such entries thus:

Drawing No.	Subject or title
3-A 211	Frame—Engines 1-21—original frame
3-A 211-A	Frame—Engines 1-21—redesigned (heavy type).

Until the completion of the betterment constant vigilance will be required to keep only the drawings applicable to the individual cases in circulation. Upon completion of the project the original drawings can be stamped "Obsolete" and transferred to that file, if one is maintained, or destroyed in the discretion of the proper officer.

Filing cabinets

In all the foregoing paragraphs, nothing has been said about filing cabinets,—in fact very little can be said except that they deserve and should get the same consideration extended to the records which they protect.

In other words, they should be as dust-proof as possible, should be easily cleaned, easy of access and located in good natural light rather than placed in some location selected mainly on the basis of its uselessness for any other purpose. All that has ever been said about the moral effect of well-kept surroundings on office personnel and the psychological effect of office cleanliness and harmoniousness on visitors includes the filing cabinet as well as the other furnishings.

Filing of correspondence

The drafting room originates few letters but receives many and the incoming correspondence is based of course, on indices unknown to any but the sender. Since nearly all of this correspondence refers to existing or pending drawings which are classified according to an established system it would seem practicable to transfer the established file-numbers or designations to the correspondence.

In this way an additional classification scheme would be avoided and knowledge of the existing system would be spread to clerical forces as well as the drafting organization proper. For example, a letter is received from a division master mechanic outlining certain defects developing in an engine truck journal box and suggesting needed changes in design. In the filing system for drawings these truck journal boxes are, perhaps, listed under classification *F* and the drawing covering the particular box under investigation is numbered 2-F-4220; the letter and copy of the reply would then be filed in compartment 2-F of the letter file where the classification mark 2-F would be instantly suggestive of the subject and also the related drawings.

An exception to this scheme has to be made in the filing of requests for blue prints in which several prints are mentioned in one letter. With these letters and replies the separation has to be effected by calendar months without other cross-referencing or indexing.

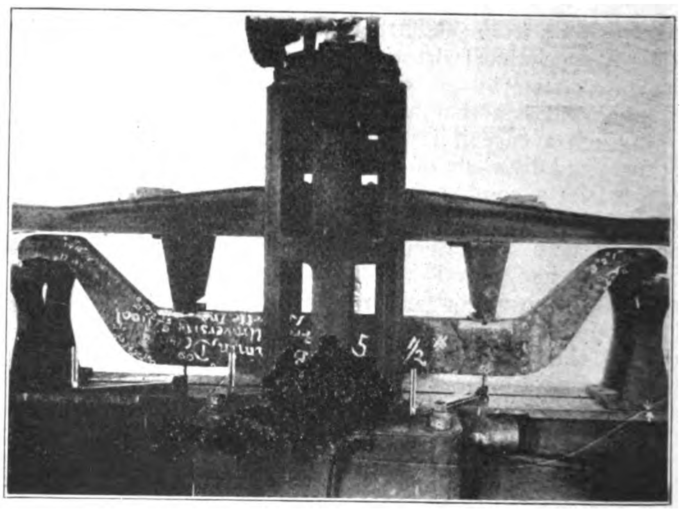
This scheme of filing correspondence is just as applicable to a detached drafting room at an outlying point as to a central organization at the general mechanical offices but the filing of drawings at division points, usually has to be greatly simplified to be readily workable by many clerks or mechanics not directly interested in the filing system.

While the storage system outlined below has many apparent disadvantages it has the great virtue of being obvious even to the poorest intelligence on a very casual inspection and is recommended on that account.

Briefly, it involves a primary separation of blue prints by locomotive classes or car classes and a secondary separation by sizes. Thus, one horizontal row of filing compartments or drawers would be devoted to engines 100-200 for example; while the next horizontal row would be given over to drawings covering engines 200-300, etc. The vertical rows would range progressively from drawing size No. 1 to the largest size. With this system a search for a drawing by a person entirely unfamiliar with the system would be localized instantly to the locomotive group involved and the chance of error would be greatly minimized, depending on the range of drawing sizes.

This method of filing is not so space-consuming as might be supposed; because in outlying districts motive power classes are apt to be restricted to the seven or eight groups of engines best adapted to the district and even where a greater diversification of locomotive types has to be dealt with, this hindrance is somewhat compensated by the fact that the individual compartments for the drawings can be greatly reduced in size from what they would have to be in a central office.

Nearly every suggestion made in this article is based on practices which emphasize simplicity above all other features. More elaborate methods and systems are possible. but since even the minor routine matters of transportation have to be covered by correspondence, drawings, maps, plans, etc., rather than verbally as in a centralized establishment; it has been judged best to use simplicity as a keynote rather than to employ a confusing multiplicity of suggestions.

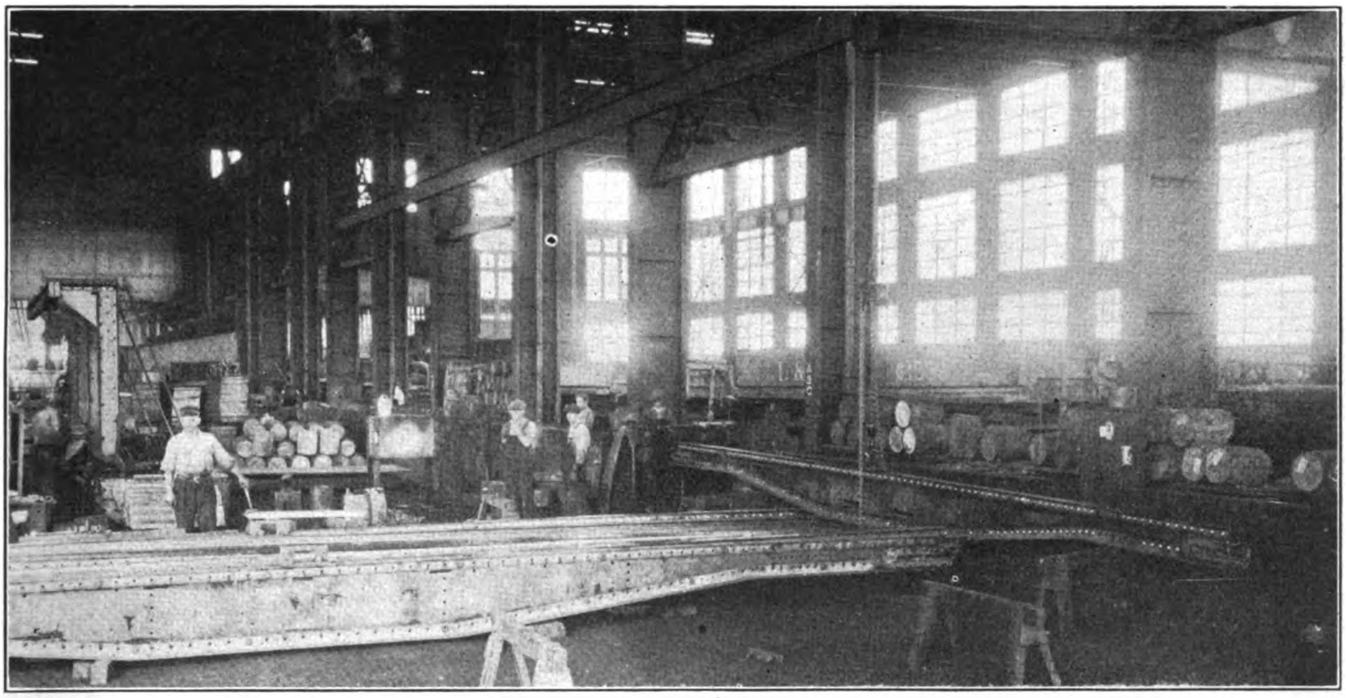


A car truck equalizer is shown mounted in a 200,000-lb. Riehle testing machine at Purdue University—The load is applied at points where the coil springs of the truck bear on the equalizer

The fabrication of steel car parts

Description of equipment and some of the methods used at the L. & N. shops, South Louisville, Ky.

THE repair work on steel car equipment, both passenger and freight, of the Louisville & Nashville, is performed at the main shops, South Louisville, Ky. Although built a number of years ago, this shop has been kept up-to-date in machinery and equipment for the expeditious handling of its work.

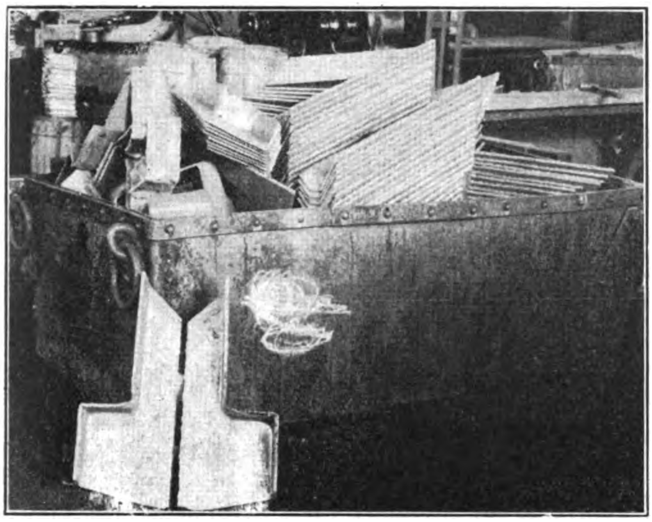


A mono-rail and chain hoist supports the web and angles while being riveted

The machinery section of the steel car shop is 88 ft. wide by 300 ft. long divided into 15 bays. It is equipped with 2 traveling cranes operating on runways the entire length of the machine section, and extending 200 ft. into the material yards, facilitating the transportation of materials to and from the building. The outside runway extends over yard tracks so that new material can be lifted direct from the car, and carried into the building, eliminating the necessity of excessive handling. When construction work is in progress one of the above cranes is used exclusively in the frame riveting position. Numerous jib cranes are located as needed for handling material at the machines.

The machine equipment consists of one triple-pressure 1000-ton Woods hydraulic press, one set of 12-ft. bending rolls, one set of 10-ft. straightening rolls, one No. 9 Ajax bulldozing machine, one Hilles & Jones No. 5 gate shear, one Long & Allstatter No. 2 vertical shear with 25-in throat, one No. 2 Long & Allstatter horizontal punch, one 50-ton, 24-in. Chambersburg hinged

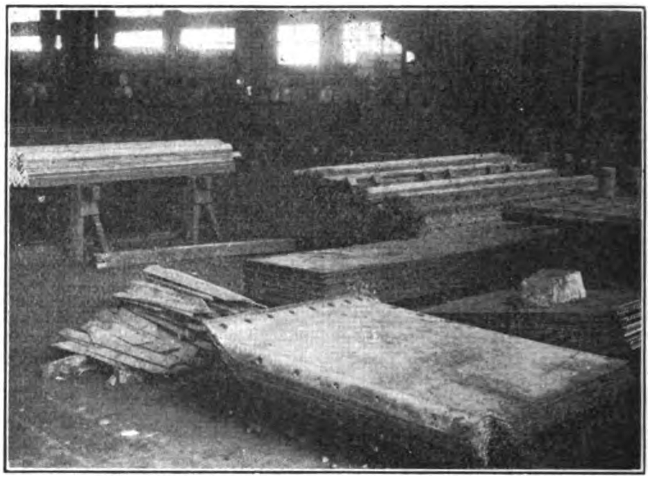
type riveter, equipped with a jib crane (this riveter is also used for bending light plates and angles when necessary), one Chambersburg 50-ton 48-in. gap riveter served by a 5-ton trolley and chain block operating on a runway extending 70 ft. each side of the riveter to facilitate the riveting of long material. The shop is further served by one No. 2 Hilles & Jones rapid action punch with 20-in. throat and one 15 hp. motor-driven angle shear, one high speed radial drill equipped with jib hoist, two straightening presses, two bulldozers, and



Corner post braces formed two at a time and cut apart with the oxy-acetylene torch

one portable pneumatic riveter. Of small machines, the list is as follows: two drill presses, one rotary shear, one 42 in. metal band-saw, one 24-in. back geared shaper, and one draft gear riveter. Adequate furnace capacity is available for changing and straightening. Layout consists of two layout men, two crane operators, 11 car men, nine helpers, and one oxy-acetylene operator.

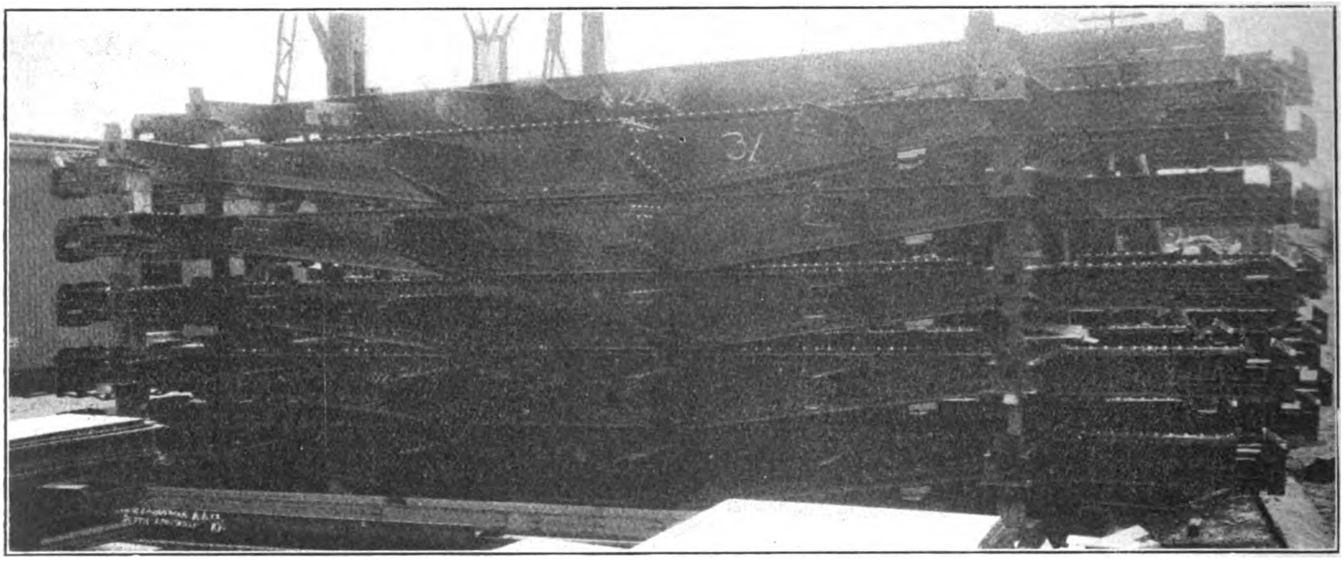
In August, work was started on new underframes for hopper bottom gondolas, and the method of handling this work may be of interest. The material is ordered



Structural steel shapes and pressings ready for assembly

for lots of 40 cars each and comes into the shop at the end near the layout table. This material includes steel plates for the center sill webs, top and bottom cover plates, crossbearers, built-up body bolsters and stiffener angles. The material is laid out, sheared, punched and anything requiring heavy flanging sent to the flange furnace and 1000-ton press. This press is used for large shapes and the bulldozer for smaller shapes.

The webs and stiffener angles are suspended by chain falls from a monorail trolley as shown in one of the illustrations, and riveted in the 48-in. gap riveter. Material for the cross beams and parts of the body bolsters



Pile of completed steel underframes at the South Louisville shops of the Louisville & Nashville

tables, straightening tables and face plates are also provided.

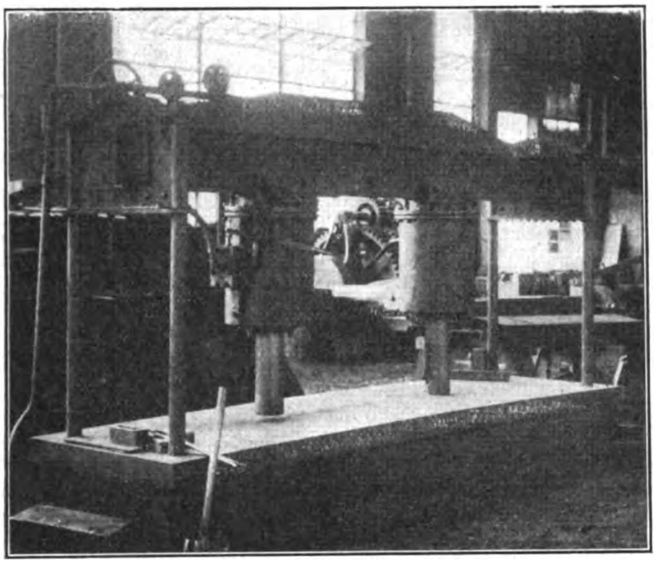
In an average month 794,785 lb. of fabricated material are turned out of the South Louisville steel car shop with a total force of 26 men, excluding those employed on erection work. The material worked up consists of: angles, 12,192 lb., channels 14,120 lb., Z-bars 104 lb., and sheet steel 768,369 lb. The working force

are punched and made ready for assembly on the main frame.

The work of erection is then carried on with two frames at a time, each worked on by a gang consisting of two car men, two helpers and one rivet heater. The underframes are set on tracks served by small electrical cranes with portable pneumatic riveting machines. One of the illustrations shows a number of these steel under-

frames completed and ready for application of the bodies.

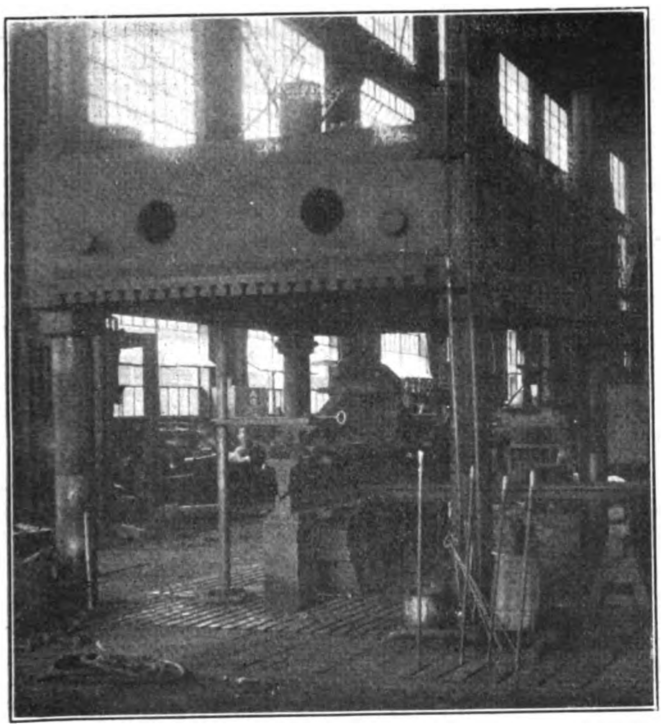
The two-cylinder pneumatic straightening machine illustrated has demonstrated its value in reclaiming steel plates and structural shapes, which, although bent and



Two-cylinder press used in straightening bent steel plates and shapes

out of shape, are not seriously corroded. These plates are heated in a nearby furnace, straightened quickly on the face plate while being held by the cylinder plungers and returned to service practically as good as new.

The limiting factor in a shop of this kind is usually



This Woods 1,000-ton press is kept busy on hot and cold press work

the hot press work and every effort is made in the South Louisville shops to schedule the operations so that the most effective service will be obtained from the 1000-ton press. In making the cornerpost braces shown in one of the illustrations, for example, two braces are made at one time under the hydraulic press and a straight cut along the center line with an oxy-acetylene cutting torch separates the two braces quickly and at a small expense. The saving in time at the press more than offsets the cost of labor and material for cutting.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Basis for computing depreciation of destroyed car

On February 18, 1924, the Chicago, Milwaukee, & St. Paul received at one of its repair shops Wabash car No. 65850 for repairs to defects due to its physical condition. Part of the defects placed the car under the provisions in the footnote to Rule 43. On investigation, the St. Paul was unable to advise the owner as to why, when and how the car failed in service, and, therefore, requested the owner for a valuation statement and a settlement under A.R.A. Rule 112. The owner notified the handling line that the car was built new during September, 1918 was five years and five months old and valued at $1,032.43. The repairing line called the owner's attention to the fact that the car received a new roof during September, 1918, and that its general appearance indicated it to be much older than designated by the owner. The owner admitted that the car had been retired and rebuilt in February, 1918, but contended that when cars were destroyed on foreign lines they should be paid for according to the dates on which the cars were reinstated after having been retired from capital accounts. The repairing line maintained that the settlement for the car should be made on depreciation based on the date the car was originally built new.

The Arbitration Committee rendered the following decision: "The contention of the Chicago, Milwaukee & St. Paul is sustained. Settlement for destruction of this car shall be made on the basis of depreciated reproduction value, depreciated from the date the car was originally built, in accordance with Rule 112.—*Case No.* 1380, *Chicago, Milwaukee & St. Paul vs. Wabash.*

Responsibility for the application of a wrong triple valve

Included in the repairs made by the Peoria & Pekin Union to Boston & Maine car No. 48904 was one K-1 triple valve applied to the car. Later, on December 24, 1923, the New York Central made repairs to the air brakes of the same B. & M. car and the billing repair card showed that one H-1 triple valve had been removed and a K-1 triple valve had been applied which was standard to the car. The New York Central's billing repair card was forwarded to the Boston & Maine, whereupon it attached the P. & P. U. billing repair card that was dated April 4, 1923, together with the billing repair card of the New York Central dated December 24, 1923, and requested that the P. & P. U. to issue a defect card covering one H-1 triple valve applied in place of the K-1 triple valve. The P. & P. U. stated that since an interval of

eight months and 20 days had elapsed between the time of the repairs made on its lines and the repairs made by the New York Central, and that since the car had moved over 22 different roads during that time. If wrong repairs existed at the time the car was repaired by the New York Central they were made by some line which neglected to furnish the B. & M. a repair card.

In rendering its decision, the Arbitration Committee stated that, "If the car was not on the home line at any time between the date of repairs made by the P. & P. U., and the date of repairs made by the New York Central, Rule 90 will properly apply, the Peoria & Pekin Union being responsible as set forth in Decisions 1027 and 1346. If the car was on the home line during the interval, the P. & P. U. is not responsible, in view of Decisions 1270 and 1285.—*Case No.* 1381, *Boston & Maine vs. Peoria & Pekin Union.*

Handling line fails to show how car was damaged

On November 26, 1923, the Norfolk & Western requested the Wabash for disposition under A.R.A. Rule 120 of its car No. 65685, but failed to show how the car was damaged. The Wabash granted the N. & W. authority to repair the car and at the same time requested the repairing line to advise the circumstances under which the damage occurred. The Norfolk & Western advised that when the car was offered to the Hocking Valley in interchange that road had refused to accept it on account of broken sills, but owing to the fact that the car was not in an accident or otherwise damaged under the provisions of Rule 32, it was not necessary to make out an accident report. A representative of the Wabash inspected the car and reported the damage indicated that it had been in an accident. Therefore, the Wabash contended that, since the handling line failed to furnish the circumstances under which the car was damaged when more than five longitudinal sills were broken, as per note under Rule 43, the handling line was responsible for the damage to the car.

The Arbitration Committee decided that "The handling line is responsible because of the failure to furnish a statement showing the circumstances under which the car was damaged, as per footnote to Rule 43. Decision No. 1302 is parallel."—*Case No.* 1382, *Wabash vs. Norfolk & Western.*

Joint evidence of wrong repairs is final

Detroit & Toledo Shore Line applied a new end running board to the "B" end of tank car C.E.R.X. No. 4166, for which it billed the Indian Refining Company in the amount of $6.91 which the owner approved and passed for payment in accordance with the requirements of A.R.A. Rule 91. The car, after being repaired, arrived at the owner's plant where, upon inspection, it was found that wrong repairs had been made to the running board which did not comply either with the owner's standard size running board for this car or, with United States Safety Appliance requirements. In accordance with A.R.A. Rule 13, a joint inspection was held and a joint evidence certificate executed. The wrong repairs in question were repaired by the owner, after which the owner presented a joint evidence certificate and D. & T. S. billing repair card covering the wrong repairs and requested the handling line to furnish a defect card for the cost of making the corrections. The handling line refused to issue the defect card, stating that its records showed that the repairs were made in accordance with the M. C. B. rules and also in accordance with United States Safety Appliance requirements.

The Arbitration Committee rendered the following decision: "Joint evidence is final as to the wrong repairs. The Detroit & Toledo Shore Line should issue its defect card accordingly."—*Case No.* 1375, *Indian Refining Company vs. Detroit & Toledo Shore Line.*

Again—Rule 32

On December 3, 1923, Atlanta, Birmingham & Atlantic car No. 5101 was broken in two in switching service on the Reading Company's lines. This car, together with some other cars, was dropped in on one switching track but after they were in position on this track they did not clear the track next to it. As a result, the cut of cars which contained A. B. & A. car No, 5101 was pushed up to the long string of cars on the track and a coupling was made without stopping. As a result, the flat car, No. 5101, broke in two. The owner contended that this was incorrect handling by the yard crew and that an ordinary stop and coupling should have been made when coupling to the second string of cars. The handling line contended that the car failed in regular switching service owing to broken and decayed sills and that the car was not subjected to any of the unfair conditions covered by Rule 32.

In rendering its decision, the Arbitration Committee stated that, "The car was not subjected to any of the unfair conditions of Rule 32. The car owner is responsible."—*Case No.* 1374, *Atlanta, Birmingham & Atlantic vs. Reading Company.*

Defect card destroyed in fire creates interesting case

On or about December 29, 1916, the Kansas City Southern rendered to the Gulf Coast Lines a bill for repairs to its freight cars. Nothing was heard of this bill until July 14, 1921, five years after it was rendered when the Gulf Coast Lines advised that the bills had been destroyed by fire and therefore, it would be necessary to have duplicate repair cards supporting the bills. All the bills were finally paid except one which contained a defect card covering repairs to C. R. L. car No. 3676 which had been damaged by fire. The Gulf Coast Lines insisted that the Kansas City Southern furnish it with a copy of the defect card, which it was unable to do for the reason that the original defect card had been attached to the destroyed bill. The Gulf Coast Lines advised that an investigation showed that the car had not been damaged on its line and that its defect card had never been issued to the Kansas City Southern. However, on January 25, 1924, a traveling accountant of the K. C. S. located the lost book of defect cards in which was a carbon copy showing that the Gulf Coast Lines had issued a defect card on the car in question. The Gulf Coast Lines denied that it had issued a defect card, stating that the card had been written but not issued and, therefore, as the car had not been damaged on its line it was the handling line's responsibility. To this the Kansas City Southern replied that if the defect card had not been issued, a carbon copy of it would not have been found and furthermore it could not have billed the Gulf Coast Lines without attaching a defect card to the bill.

In rendering its decision, the Arbitration Committee stated that, "The evidence shows that repairs to C. R. L. car No. 3676 were billed on the regular authority of a defect card. Rule 15 also applies. The charge in full, is sustained."—*Case No.* 1373, *Kansas City Southern vs. Gulf Coast Lines.*

Chief Interchange Inspectors' proceedings

Special attention given to the subjects of billing and progressive rebuilding of house cars

AT the twenty-fifth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held at the Hotel Sherman, Chicago, September 21 to 23, a partial report of which appeared beginning on page 607 of the October *Railway Mechanical Engineer*, considerable attention was given as usual to the subject of billing. A paper on the preparation of A. R. A. billing repair cards and record of repairs simultaneously at the car was presented by C. C. Hennessey, head A. R. A. clerk of the Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis, Ind. The progressive rebuilding of house cars was described by C. M. Hitch, district master car builder of the Baltimore & Ohio at Cincinnati, Ohio. Abstracts of these two papers appear in this issue. The discussion of the A. R. A. rules will appear in a subsequent issue.

A. R. A. record and billing repair cards

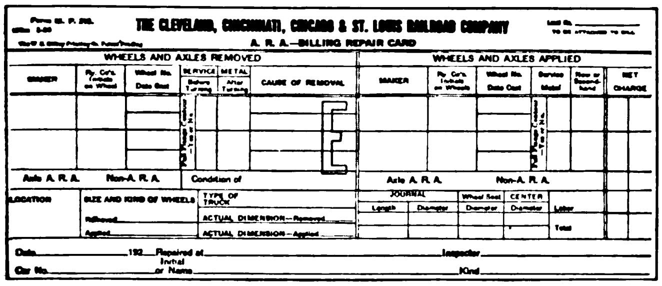
By C. C. Hennessey

Head A. R. A. clerk, Cleveland, Cincinnati, Chicago & St. Louis. Indianapolis, Ind.

The practice of making in one operation at the car the original record of repairs and billing repair card as required by A.R.A. Rules 7 and 8, and the supplementary regulations to those rules has now been in successful operation at all repair points on the Big Four for one year.

This is a money saving method for authorizing, recording and checking repairs to railroad cars and billing for or reporting those repairs to the car owner as required by the A.R.A. rules.

In order that the thin sheet of paper which comprises

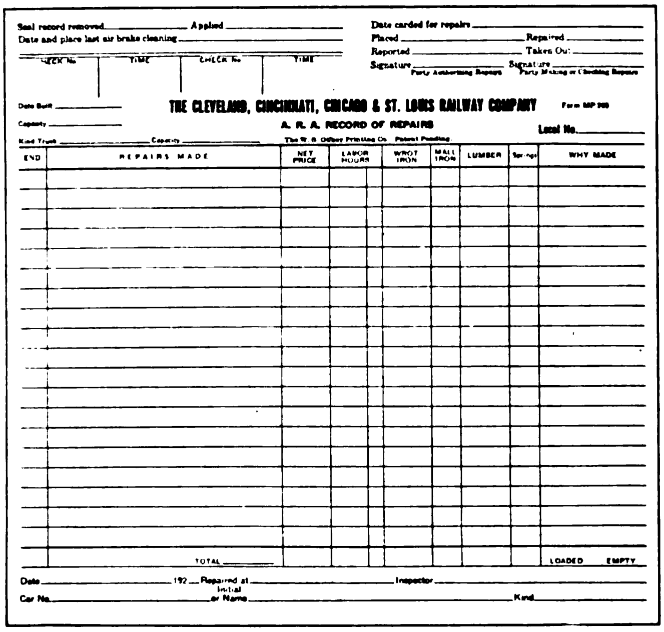

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RAILROAD COMPANY
A. R. A.—BILLING REPAIR CARD
WHEELS AND AXLES REMOVED
MAKER | Ry. Co's. Initials on Wheel | Wheel No. Date Cast | SERVICE METAL Before Turning | After Turning | CAUSE OF REMOVAL
WHEELS AND AXLES APPLIED
MAKER | Ry. Co's. Initials on Wheels | Wheel No. Date Cast | Service Metal | New or Second-hand | NET CHARGE
Axle A. R. A. Non-A. R. A. Condition of
Axle A. R. A. Non-A. R. A.
LOCATION | SIZE AND KIND OF WHEELS | TYPE OF TRUCK
Removed | ACTUAL DIMENSION—Removed
Applied | ACTUAL DIMENSION—Applied
JOURNAL Length Diameter | Wheel Seat Diameter | CENTER Diameter | Labor | Total
Date ______ 192__ Repaired at ______ Inspector ______
Car No. ______ Initial or Name ______ Kind ______

This form made in triplicate is carried in the aluminum box holder

this complete combination of the two cards or records may be written upon out of doors under all weather conditions, without handling the sheets and carbon paper on the repair tracks and to protect the cards from rain and soil while they are on the car during the time it is undergoing repairs, it is necessary that some practical means be provided that will accomplish these results without slowing up the supervision or outside forces in authorizing, recording and checking the repairs.

We have found that the best practical means so far developed for this purpose on the shop or repair tracks is the two leaf aluminum folder. We have in service a number of three leaf aluminum folders that will hold four of the large cards, but as two of these cards will take care of the work on the usual run of foreign cars, we are now using the two leaf folder which holds two of these large cards and in case of exceptionally heavy repairs where more than two cards are required for a car, we use an additional folder on that car. This reduces the cost of the folder as well as its weight.

Folded combination billing and record cards, with carbon paper in place for foreign cars and single record


Seal record removed ______ Applied ______
Date and place last air brake cleaning ______
CHECK No. | TIME | CHECK No. | TIME
Date carded for repairs ______
Placed ______ Repaired ______
Reported ______ Taken Out ______
Signature ______ Party Authorizing Repairs
Signature ______ Party Making or Checking Repairs
Date Built ______
Capacity ______
Kind Truck ______ Capacity ______
THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RAILWAY COMPANY
A. R. A. RECORD OF REPAIRS
Local No. ______
END | REPAIRS MADE | NET PRICE | LABOR HOURS | WROT IRON | MALL IRON | LUMBER | Springs | WHY MADE
TOTAL ______ | LOADED | EMPTY
Date ______ 192__ Repaired at ______ Inspector ______
Car No. ______ Initial or Name ______ Kind ______

This form made in triplicate is carried in the aluminum folder

cards for home cars are inserted in the aluminum folders by a clerk in the car foreman's office, whose duty it is to keep a sufficient supply of aluminum folders with cards and carbon paper in place at a designated location, so that the prepared folders are always ready for use.

Folders distributed in flat closed position

In some folders we place two cards for a foreign car; in others, one card for a foreign car and one card for a home car, and in others two cards for a home car, all depending on the number of foreign and home cars and class of repairs usually made at each repair track. The folders so filled are kept in separate piles, each pile being suitably marked so that the cards can be distributed to the cars as needed. At points where no clerk is em-

ployed, this duty is usually performed by the car foreman.

As soon as bad order cars are placed on the repair tracks, one folder with cards and carbon inserted, is placed on one truck of each bad order car by a laborer, checker or other designated person. The folders are always placed in flat closed position on any convenient part of the truck, such as the end of the truck bolster, on the oil box or arch bar and on the same side of each bad order car on the track. The reason for always placing the folder in flat closed position on the truck is that the folder will then shed rain or water dripping from the car.

The person authorizing repairs inserts the car initials, number and kind of car and draws a line through the word "Loaded" where the car is empty, or draws a line through the word "Empty" where the car is loaded. He then writes each item of repairs to be made in the "Repairs Made" column, and a full description of the broken, defective or missing parts in the "Why Made" column, using judgment in regard to the number of vacant lines to be left under the first item before the second item of defects is entered in the "Repairs Made" column, in order to provide room for a full description by the party checking repairs, of the material applied, such as the make, type and size of coupler, whether new or second hand, etc., which information cannot be determined until the repairs are made. He then signs his name in the space provided, closes and places the folder back on the truck.

The car is now ready for the repairmen, who refer to the billing repair card in the aluminum folder and make only such repairs as are authorized.

Careful checks are made

After the repairs are made the person checking the repairs verifies the correctness of car number, initial, kind of car and whether loaded or empty; inserts the date built, capacity of car, kind and capacity of truck and makes sure that the forms carry a full description of all repairs made, the correct reason why the repairs were made and all information required by the A.R.A. rules. He then inserts the date of the repairs and signs his name in the space provided. The folder is now ready to be taken up and returned to the shop office by the checker, foreman or other designated party.

When the work of checking the repairs is completed, the folders are ready to be taken up and placed at a designated location in the shop office for prompt handling by the clerk or person who removes the completed cards from the folders, refills them and places them at the specified location, where they will again be readily available for use.

Any corrections necessary must be made by crossing out the item and writing in the corrections; no erasures can be made.

For repairs made on authority of defect card, the billing office writes the separate billing repair card required by the third paragraph of Rule 8.

The foreman of each repair track is held responsible for knowing that a folder is removed from each car leaving the repair tracks, including "set backs" and for placing the same folder on each "set back" car when it is again spotted on the repair track.

Each foreman or checker on the repair tracks is supplied with an aluminum box holder in which is carried blank wheel and axle repair cards with carbon paper between the fold of each card. This aluminum box holder is light and when opened forms a handy means upon which to write in all of the wheel and axle information required by the headings of the small A.R.A. wheel and axle billing repair card.

This wheel and axle form is filled out in detail at the car before the wheels removed are rolled or carted away to the wheel shop or loading platform. The person checking wheels is required to sign his full name in the space provided on each wheel and axle form and then to place the form, together with the bad order cards and all defect cards removed from the car, under the spring in the aluminum folder for that car, so that when the folder arrives at the shop office it will contain all repair cards, wheel and axle cards, defect and bad order cards for each car, unless two folders are used in the same car in which case all cards will be contained in the two folders.

Inspectors in transportation yard have holders

Each inspector in the transportation yard is furnished one of the aluminum box holders, in which is carried a supply of folded repair cards, with a sheet of carbon between the fold of each card, ready for use on foreign cars and a supply of single repair cards for use on home cars. These blank cards are placed in the top or upper compartment of the box, with the perforated edge of the folded cards at the top edge or side of the compartment. After opening the box which is hinged along its center either style of card is readily removed by placing the fore finger of the left hand in the hole in the bottom of the compartment, pushing all cards up from the bottom of the box so that they are easily pulled out with the thumb and fore finger of the right hand. The card while being written upon is held on the top section of the box under the thumb of the left hand which holds the box, the lower sections of the box forming a rest for the right hand while writing. After the repairs made to each car have been completed, one of these cards is filled out in detail at the car by the inspector or repairman who made or inspected the repairs and that party signs his own full name to each repair card, which is then deposited in the lower compartment of the box, wherein it is carried by the repairman until he returns to the shanty. The cards are removed from the lower section of the box, by inserting a pencil under all cards in the compartment and lifting them up so that they are all easily removed.

When repairs are made in transportation yards on authority of a defect card, the defect card is placed between the fold of the repair card where it remains until both the repair and the defect card arrive at the shop office.

The carbon paper is not removed from between the fold of the repair cards by the inspectors. All repair and defect cards are accumulated from all inspectors and forwarded at the close of each day to the shop office, where the clerk applies a local number to each repair card for each foreign car, after which the carbons are removed, the billing and record portions of each card separated and the billing repair cards forwarded daily to the billing office. The record of repairs for both foreign and home cars is filed at the shop office in a file case numerically according to the last two numerals in the car number. Repair cards from the repair tracks are handled in the same manner by the shop clerk.

Economies and advantages of this system

At line inspection or one man points, each inspector is furnished an aluminum box holder and at these points the work is handled in exactly the same manner as in the large transportation yards, except that the inspector applies a local number to each card, separates the billing and record portions, mails all billing repair cards to the billing office daily and mails his record cards for both foreign and home cars, daily to the division or district shop office where the records are filed.

To install this system at all repair points on the Big Four, 2,000 aluminum folders and 500 aluminum box holders were required. This system has several economies and advantages over the former practice of copying the billing repair card from a separate record.

It eliminates all clerks whose entire time is devoted to writing billing repair cards. This one item produced an annual payroll saving of $13,121.40 for the Big Four, which represents the annual salary of clerks taken off the payroll and their rates abolished.

The clerks, a portion of whose time was formerly devoted to writing billing repair cards, are now available for other work.

It eliminates all transcribing errors. It saves in correspondence and time in verifying car initials and numbers. The majority of the mistakes in car initials and numbers are made in transcribing from the original record to the billing repair card and when you eliminate these transcribing errors you save time and expense for the road making the repairs and also for the road that receives and checks your car repair bill.

A saving in stationary and filing space is effected by the elimination of the duplicate records.

It keeps the making of billing repair cards up to date at all times without additional clerical work on the supervision or outside forces.

It gives to the car owner first hand information regarding repairs made to his car and the reason for those repairs and prevents the clerk who writes billing repair cards from supplying any billing information that was not recorded at the car, which practice may be more or less prevalent where the billing repair card is copied from a separate record.

It makes available for constructive work, the time of the traveling A.R.A. inspector formerly spent in checking the record repair cards against the work cards. It enables the traveling inspector to obtain from the billing office information regarding the points most in need of his service, and provides able assistance to him in his efforts to educate the men on the A.R.A. rules and to locate promptly and instruct any one who is lax.

To insert carbon paper in 50 shop cards, 20 wheel cards and 50 train yard cards, and to insert and remove the 50 shop cards from the Aluminum folders, remove the carbon paper and separate the billing and record portions of the 120 forms requires approximately 30 minutes clerical labor. The time required for the distribution and collection of the aluminum folders to and from the cars will vary according to the conditions and general layout at each repair track. This clerical and outside work was absorbed at each repair point on the Big Four without additional cost to the railroad.

The aluminum folders and aluminum box holders are light and durable; they will not rust or corrode, and with ordinary handling their first cost is the last cost.

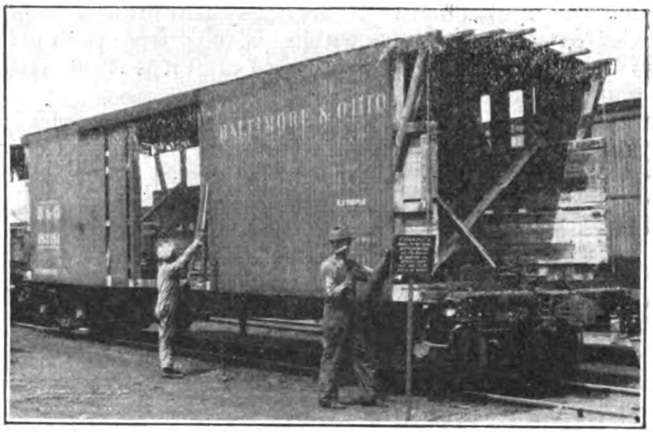
Progressive repairs to house cars

By C. M. Hitch

District master car builder, Baltimore & Ohio, Cincinnati, Ohio

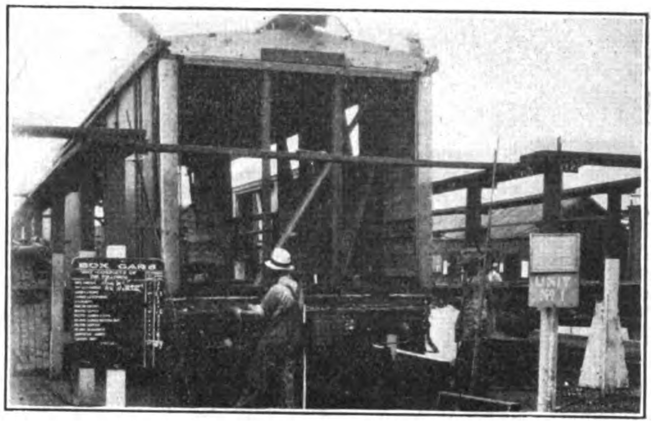
All cars requiring 60 man-hours or over are repaired on the progressive or spot system. We find that this system has improved our conditions materially and is the best way to repair or rebuild cars, being far superior to old methods.

The spot system provides that certain repairs to a car will be performed at designated spots on designated repair tracks in shops or on shop yards where heavy or rebuilding repairs are made. The work is handled in four different ways, as follows:

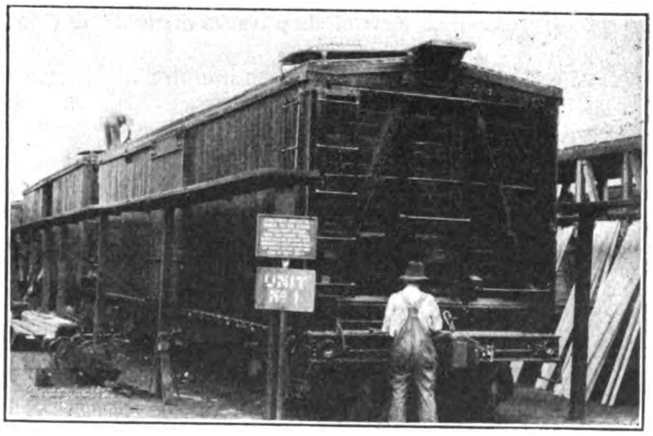


Station A—Stripping car for repairs by removing defective parts that are to be renewed or repaired

1—When repair tracks or shop tracks are sufficient in length to have 18 cars placed on each track, each track having switch connections on both ends so that cars can be started in on one end at the stripping spot and then move from spot to spot until completed ready for service, the force on such track should be employed at six spots, each one sufficient in length to hold three cars, so that all cars can be moved up one spot at the close of each work-



Station C—Repairing and fitting to place on house cars all framing above the underframe preparatory to the application of siding, and apply inside lining, floor and bevel strips



Station E—Apply all safety appliances, hang and adjust doors, repair air brake and hand brake equipment, and apply the second coat of paint after the quitting time of the first shift

ing day until completed. Such a system insures completion of repairs to a car within six days from the time it enters the first spot to be stripped until it is repaired and returned to service.

2—When repair tracks or shop tracks are not sufficient in length to hold 18 cars then, 18 cars can be spotted on two adjacent tracks sufficient in length to have three spots on each track holding three cars each, or a total of 18 cars on two adjacent tracks. Cars placed for repairs on such tracks are first placed on the stripping spot, which is located on the entering end of the track, and the cars are moved at the close of each day from spot to spot over one track and back over the other to the end of the adjacent track. On such tracks one unit of the force is worked on two tracks in place of one track as above.

3—When repair tracks or shop tracks have a stub end on one end and switches connecting up the tracks on the

Two columns are provided on this bulletin board, one to show the number of each kind of workmen composing the unit, and the other filled in with chalk immediately after starting to work each day by the unit foreman to show the number of such workmen reporting for work.

On the side at the corner of each car is placed a bulletin, painted black on one side and bright red on the opposite side. The black side shows the date the car was placed on the first spot for repairs, and the date it will be completely repaired and returned to service. The bright red side shows the words in white letters, "Material Wanted." This side of the bulletin is placed out when material cannot be obtained with which to repair cars and to show that the car is passing through the spot system needing material to repair it which could not be obtained.

Cars of the same kind and class when possible should be worked through the spots of each unit to insure

General view of shop tracks of the B. & O. at Washington, Ind., where unit and spot work is done

opposite end, there should be a minimum of six tracks in such shop or shop yard, and the tracks should hold a minimum of three cars each. Such facilities provide for one unit of force to be worked on the spot system across the shop or shop yard.

If each one of the six tracks holds six cars on each track there are two spots on each track with three cars in each spot, where two units of force can be worked across the shops.

If each one of the six tracks holds nine cars on each track there are three spots with three cars in each spot, and three units of force can be worked across the shop.

Each unit of the force worked is assigned to certain tracks or track in a shop or shop yard.

At the first spot of each unit there is placed a bulletin board bearing the names of the unit foreman in charge and the assistant unit foreman, and showing the kind of workman assigned to the foreman.

maximum output. Repairing cars in this manner insures more satisfactory output and better work than if cars of a mixed class and kind are allowed to pass through the spots of each unit.

At shops where more than one kind of cars are being repaired the units repairing each kind of cars should be segregated as much as possible. If, for example, a shop is repairing both house cars and open top cars, one kind should be worked on one side of the shop and the other on the opposite side. This proves more satisfactory than to mix cars indiscriminately, as it separates the force better and segregates material used to repair the cars.

Advantages

This system of handling car repair work assures maximum production and minimum loss of material due to damage and waste. It further provides supervision that

is both pleasing to the workman and productive to the employer, because when advice is needed by the men it is promptly obtainable, making the conditions under which the employee is working satisfactory.

It provides maximum safety for the workman, because his work is done at a designated spot where the required facilities and material are placed, making it unnecessary for him to collect his own material and tools from scattered points in the plant, which may subject him to all the hazards that exist on the entire property.

It provides for maximum conservation of material because material suitable for work to be done at each spot is removed from the car and re-used at the spot where it is removed; or, when new material is needed, it is placed at the spot for use by designated material men.

Unit organization and spot system encourage the employer to provide steady employment for his employees for the reason that it makes production cheaper than can be obtained through any other means.

Question box report

The Question Box Committee considered and reported answers on 35 questions which had been submitted to it. In the discussion which followed the presentation of the report, the association voted to rule out questions 7, 11, 12 and 22 as being either not clear or irrelevant. The questions and answers are printed below serially as numbered by the committee, with these four omitted.

1—The A. R. A. Manual of Standard and Recommended Practice, March, 1925, pages B-45, 46, shows wheel cast iron, limit gage for remounting. This gage is not shown in A. R. A. rules and as it is used by foremen to determine whether or not cast iron wheels can be remounted or not, should it not be shown in A. R. A. rules with instructions regarding the proper method of using it?

A—See page 98, page 98-A, interpretation 3.

2—Stencilling of 40,000-lb. and 60,000-lb capacity cars which have non-A. R. A. axles has not been satisfactorily explained, as Rule 86 does not cover. Kindly explain the proper method of stencilling this class of equipment until expiration of time limit for non-A. R. A. axles.

A—See minutes meeting March 3, 1926. Supplement 2, Paragraph H.

3—How should depreciation be figured on an all steel car which has been rebuilt from a composite car, using the trucks and the steel center sills of the old car which have the A. R. A. required strength. In rebuilding, should depreciation be figured from the date the composite car was built, or the date the all steel car was built?

A—From the date originally built. See interpretation 3, Rule 112.

4—Road A passes Road B's bill for car repairs and takes certain exceptions, which are adjusted by Road B. Five months after receipt of the bill and 90 days after the bill was passed for payment, Road A finds that a duplicate charge existed in Road B's bill. Road A calls this to the attention of Road B and requests cancellation of one of the charges. Road B refuses, claiming that exception should have been taken within 60 days from the date the bill was passed. Is Road B correct?

A—Yes. See Rule 91, section C, Interpretation 5.

5—Road A receives a box car from Road B with doors bulged on account of the load shifting. The doors had originally been protected, but this protection was broken. The load was adjusted and new door protection applied and bill made against Road C, the originating carrier. Road C refused payment, claiming that proper protection had been applied by the shipper. Who should stand this expense?

A—Road B; delivering line responsible.

6—Road A receives box car from Road B loaded with cement in bags. The load is shifted and the doors bulged. Road A adjusts the load and applies door protection, billing the expense to Road C, the originating carrier. Road C refuses payment, claiming that cement is not a commodity requiring door protection and that no charge is in order. Who is right?

A—Road B. Delivering line responsible.

8—Do items 11 and 12 of Rule 111 cover all cases of cylinder gasket renewal, even though the repairing line claims that it was necessary to R. & R. cylinder?

A—Where the construction of the car necessitates cylinder removal to apply gasket, additional charges can be made.

9—If we remove a defective truck side from a foreign car and apply one of different make on account of which we have to change the opposite truck side to correspond, is the opposite good truck side second or scrap? It is not an A. R. A. standard. When we apply defect card to cover this change, we pay for labor and material and the owners invariably credit us with scrap on the good sides removed. Should we do likewise when removing the owner's standard?

A—The opposite truck side is second-hand. Apply defect card, labor and material to both wrong frames applied.

10—Explosive rules ask for the removal of dome cantion cards from all empty tanks. When this is done during night hours, are we not violating other Bureau of Explosive rules, which tell us to keep lights and fires away from all tank cars?

A—Use electric lanterns. See page 233, Bureau of Explosive pamphlet "J", also page 235. Never use lighted lanterns.

13—Regarding Supplement 2, note to Rule 101, on friction draft gears: How should credit be given for gear removed having friction casing and other parts defective, but not all parts of the gear defective?

A—Rule 101, effective January 1, 1926 explains. Arbitration case 1474.

14—Can rivets charge be made per Items 439 and 440 of Rule 107 on rivets used in the manufacture of new sill steps with center tread and new side and end ladders, which have handholds riveted to stiles.

A—Rule 101, Item 188-A covers.

15—If a Simplex coupler lock complete is applied and the lifter is new and lock block second hand, what charge can be made?

A—Item 189, second-hand lock.

16—Regarding Rules 73 and 83: To condemn wheels account worn through chill, must the spot be 2½ in. flat or 2½ in. from edge to edge of the spot?

A—Edge to edge.

17—Can a charge be made for the renewal of a defective check valve case when the brakes are cleaned at the same time. If so what change can be made?

A—No charge can be made.

18—Regardnig use of remounting gage: For uniform understanding, must this gage be held horizontally when gaging for a thin flange or must it be set flat on the tread and over the flange, leaving the gage in slightly tilted position, due to contour of wheel tread?

A—See page 98-A, 1926 rules, which shows gage resting on tread and over the flange.

19—Regarding Rule 65: Is the charge against owner proper for renewal of truck sides, arch bars, oil boxes or wedges, which have been cut through by the journal due to the brass being broken and lying in the bottom of the oil box?

A—Not covered in Rule 65; however, some interchange inspectors issue cards to include the box and wedge, when cut through by the journal. We suggest this question be referred to the A. R. A. for a ruling.

20—Rule 111. Do you recommend that an interpretation be added to rule, answering the following:

Where dirt collector is cleaned as per item 18 and dirt collector deflector and plug is found to be broken or is broken in removal, can both material charge as per Rule 101, Item 16, and labor charge as per Rule 111, Item 18, be made?

A—Yes.

21—Rule 107, Item 368: Recommend this item be revised, to show what is meant by "other sills." The question is now raised does it mean other than side or intermediate sills, or simply any other sill, and would it cover an end sill renewed at the same time?

A—Longitudinal sills only.

23—Rule 107, Items 170 and 171. Recommend that an interpretation be added, answering the following question: Where short metal draft timbers or arms are renewed and also wooden draft arm extension block is renewed at the time and the same end of the car, can a charge be made for both items, as per the above labor items?

A—The labor charge is the same for one or both items.

24—Rule 12, paragraph 5: A car moves from Road "A" to owners on June 1, then on July 1, the car moves to one or more foreign lines and back to home rails on July 31. The owner obtains joint evidence for wrong repairs and finds repair card issued by road "A" dated May 30. The owner's joint evidence is dated August 10. Can this joint evidence be considered as being obtained within 90 days of first receipt on home rails? It should be remembered that in the event of another foreign line, other than a direct intermediate, making repairs, the foreign repair card could not be considered as joint evidence. It is my opinion that the same should be true of a joint evidence card obtained by

the owner where the car has been on the owner's rails and then off again before he obtained joint evidence.

A—Joint evidence valid. Defect card should be issued to cover wrong repairs.

25—Rule 20: In adjusting the height of couplers, this rule states that empty cars measuring 32½ in. or less, shall be adjusted to 34½ in., or as near as practical thereto, but not exceeding 34½ in. Loaded cars measuring 31½ in., or less, shall be adjusted to 33½ in., or as near as practical, thereto, but not exceeding 33½ in. The Manual of Standard and Recommended Practice reads as follows: "In order to justify a bill for work done under the rules of interchange, an empty car should be adjusted to 34¼ in., maximum, 34½ in. minimum, and when it is necessary to alter a loaded car, it should be adjusted to 33½ in. maximum, 33¼ in. minimum. Are we justified in taking exceptions when heights are not in accordance with Manual of Standard and Recommended Practice?

A—See minutes of meeting Arbitration Committee, March 25, 1926. Rule 20 governs, manual to be changed.

26—Rule 70: should a defect card be issued for labor only, when applying wrought steel wheels (multiple wear), instead of cast steel wheels when the car is stencilled cast steel standard.

A—No.

27—Rule 86: Is the owner justified in using another railroad's repair card as joint evidence when wheels and axles have been changed previously by other foreign lines, when the axle is scrapped on account of length of journal being below limits of wear, claiming that axle was scrapped when applied by a foreign line.

A—This question is now in the hands of Arbitration Committee, docket 1426 and 1552.

28—Rule 107, Item 299: Slats, side or end, or side door, bolted R & R or R, per bolt, 0.3 hours: Under Rule 107, Item 179, end gate or planks, or end planks on gondola cars, and Item 374, stakes end or side on gondola cars, per bolt or rod, 0.2 hours. We would like to be advised why we are allowed 0.3 hours on item 299 and only 0.2 hours on other mentioned items.

A—The question should be handled with Price Committee. It is partly clarified by supplement 1.

29—Rule 101: We are receiving foreign cars equipped with No. 4 A. R. A. brake beams, but have no price for them.

A—No. 4 brake beams are not A. R. A. standard, the charge should be according to Rule 105.

30—Rule 111: Should any overlap labor be deducted when cylinder or reservoir are renewed in connection with air brakes cleaned at the same time?

A—Overlapping labor, 54 cents; total charge, 72 cents. Certain items of labor in connection with air brake cleaning overlap on account of renewing cylinder and reservoir, such overlap items which are not necessarily R & R account cleaning, should be charged.

31—Rule 23: When a body bolster is welded, but not annealed, can we render a bill against the car owner?

A—No.

32—Interpretation 3, to Rule 98 relative to wheels condemned by the limit gage for remounting: If a pair of wheels is removed from a foreign car on account of cut journals and it is found that the wheels are condemned by the remount gage, is it permissible to take the pair of wheels and true the journal on the axle, providing the axle can be trued without scrapping it, and replace these wheels (condemned by the remount gage) under the car from which they were removed? If such a procedure is wrong, what is the penalty for making such repairs?

A—No penalty, unless wheels are pressed off axle.

33—Does failure to apply grip nuts to box bolts on tank cars when applying box nuts on account of owner's defects, cancel subsequent charges by the same road for applying box nuts on the same bolts, account of missing?

A—No.

34—Rule 70: In view of the fact that this rule provides that wrought steel wheels (multiple wear) may be substituted for cast steel wheels, while at the same time the repairing line is changing the car owner's standard, is it the understanding of your committee that no defect card is due? If a defect card is due, how should it read, it being understood that proper charge and credit was made at the time the bill is rendered covering wrong wheels.

A—No defect card is due.

35—Rule 88: A road repairs a foreign car by applying a wrought iron coupler yoke in place of a broken cast steel yoke. Is a defect card due for labor only?

A—No.

New York Central.—This company has awarded contracts totaling approximately $758,000 as follows: to the National Boiler Washing Company, Chicago, for the installation of a boiler washing and filling system for locomotive boilers in enginehouse at East Syracuse, N. Y., estimated cost $70,000.

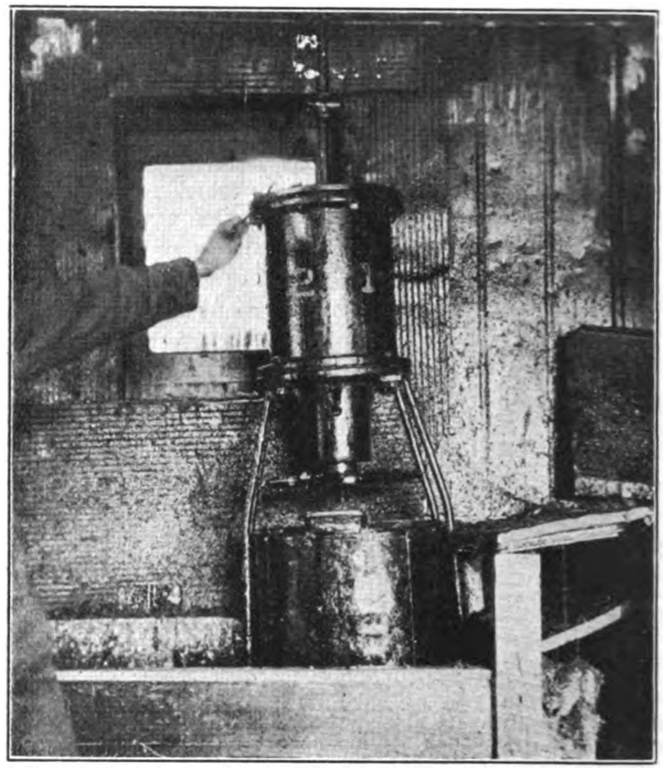
Renovating car journal packing

By Joseph C. Coyle

Hot boxes are costing the railroads thousands of dollars yearly, the greater portion of which might be saved by employing men skilled in journal lubrication, and by proper renovation.

Even where there are very good renovating facilities there is often a practice of "shaking up" old packing and replacing it in journal boxes without even washing it. Of course, many of the larger particles of foreign matter assimilated by old packing are removed in this way, but as a rule, it is not these that get under the bearings and cut the journals. The only way to remove fine particles of grit is to wash the packing in hot oil.

An excellent method of renovating old packing is that



Application of an airbrake cylinder for renovating packing

employed by the car department of the Denver & Rio Grande Western, at Denver, Col. The packing, when removed from the journal boxes, is taken to the plant and placed on a warming table until it becomes pliant. It is then thrown in a large steel tank, containing a half inch mesh screen, several inches from the bottom. This screen is covered to a depth of several inches with oil, warmed by steam pipes beneath the tank.

At one end of the tank an air press is rigged up with an old brake cylinder, as shown in the illustration. A 15-in. by 15-in. double bucket, of steel, slides on a track of angle iron beneath the press and secured to the cylinder above by four long bolts. The inner section of this bucket is perforated with small holes, while the outer part is bottomless and has a handle at the top for manipulating it. A cut-off valve, with a small vent hole bored in one side, applies and releases the air in the pipe above the cylinder. A circular plate of steel forms a pressure plate, which is secured on the threaded piston.

After stirring the packing well with a fork, it is put in the bucket and pressed, to remove the surplus oil and, with it, still more foreign matter.

Modern lacquer for railroad use*

A discussion of the nature and properties of lacquer—History of its development

By Arthur Orr
Commercial Solvents Corporation, Terre Haute, Ind.

As the clearing house or perhaps even as the court of last resort for decisions and judgments that are bound to have a powerful effect on the future efficiency of our great aggregation of railroads you have established your reputation and in proportion as your prestige is great so must your recommendations be wise. In this instance, however, your duty is particularly delicate and difficult. You are asked to consider a material relatively new, requiring a strange technique for its application and shop facilities different from those you now possess.

When you have to choose between several types of raw material or mechanical devices each intended for the same purpose in its field and each with a long record of performance behind it, you have merely to compare the experiences of various roads, with their particular variations, and by almost arithmetical certainty, arrive at your conclusion. Definite information on cost, upkeep, factor of safety, per cent of failures and other points which enter into the equation are all available for comparison. There is not much chance of making a mistake.

In this case, although I realize of course, that any question of recommendations is premature, you are in a very different position. The facts are meager—they are based only on experimental applications stretching over a short period of time. Adequate facilities for efficient application have been conspicuous by their absence, and workmen have been generally unfamiliar with, and unsympathetic to the strange materials and tools they were called on to use. Furthermore, but not unnaturally, most of these lacquer applications have set out to imitate a paint or varnish finish pretty much as if a contractor using steel and concrete were required to build a house to look as if it were made of wood.

Your opinion, therefore, about the usefulness of lacquer for your purposes must of necessity be based on different and broader grounds than if you were considering several varieties of a definite device each with an exact record of performance behind it.

The history of lacquer

The word lacquer was first applied to an oleoresinous finish in various far eastern countries where it was developed to a very high standard of artistic and mechanical perfection. This oriental type of lacquer has been used for about 3,000 years. It dries exceedingly slowly and can, therefore, have no practical interest where time of application is a factor. Nitrocellulose, which is the distinguishing ingredient of modern lacquer, was first discovered about 80 years ago. Solutions of this material in alcohol and ether called "Collodion" found some medicinal and other minor uses. Solutions of nitrocellulose were first used industrially about 40 years ago chiefly for preventing tarnish on polished metal surfaces. Even very thin, transparent films of this old-style lacquer were found to be very effective and durable for this purpose. Until about eight years ago, however, it was impossible to make these solutions heavy enough to apply other than a very thin coat. Shortly after the war this disadvantage was overcome and today, although our commercial lacquers do not possess as much body and filling power as the average varnish, the film produced with a single coat is several times as thick as the films made with lacquers 10 years ago. This increased thickness of film made it possible to introduce inert pigments which in turn made lacquer available for use on surfaces exposed to direct sunlight. A clear lacquer film is destroyed by direct sunlight in about the same length of time as a clear varnish film, but a pigmented lacquer will withstand outside exposure without breakdown for a much longer period than pigmented oleoresinous films. This is a strong statement, but it is amply supported by the experience and the carefully conducted tests of many automobile manufacturers.

The manufacture of old-style lacquer for protecting metal surfaces has been a definite, well-established industry for over 30 years. About five years ago, with the advent of low viscosity cotton, which made thicker and pigmented films possible, the applications of lacquer began to increase very rapidly in variety and in volume. This increase was so sudden that it called for a corresponding jump in the supply of raw materials, particularly the solvents which were necessary in obtaining sound, adherent films. After some initial difficulties, this problem was solved and there is today not the slightest reason to fear any shortage in lacquer solvents or any of the other raw materials required, however great future developments may be. With the improved nitrocellulose or cotton and the ample supply of good, pure solvents which became available about three years ago, lacquer began its invasion of several industries which had never used it before.

Furniture manufacturers found in lacquer a quicker, more durable finishing material. But the most startling chapter in its history has been written by the automobile industry which has now adopted lacquer almost to the entire exclusion of other final finishing materials. All automobile companies in this country today use lacquer on some of their output. A great majority finish all their cars in lacquer in spite of the fact that most of them began its use less than two years ago. Although the priming and surfacing coats on most automobiles today are still made of oleoresinous materials, some makers use lacquer primers and surfacers as well as lacquer finishing coats.

Lacquer today is used on a variety of surfaces too numerous to mention. It is not used on surfaces where merely temporary protection is required, or where first cost per gallon of coating material is the determining factor. The true measure of value is, of course, total cost, including material and application per square foot of surface per year of life, at a given standard of appearance. Measured by this test, it is logical to believe that the use of lacquer will continue to increase for sev-

*Abstract of an address before the Equipment Painting Section convention, held at Detroit, Mich., September 14 to 16, 1926.

eral years to come. In each of the preceding three years the gallonage of lacquer produced has roughly doubled. It is estimated that twenty million gallons will be produced this year. So much for the history of lacquer development, which, after all shows how the wind is blowing, and gives us some clue to what may happen in the next two or three years.

Lacquer development hastened by automotive industry

If, as a railroad official, you were called on to make a decision on the policy your company should follow with respect to lacquer you would secure information on several points. You would study the history of lacquer development; you would make sure that its production is well established and capable of any necessary development; you would examine the mechanical characteristics of a lacquer film and the conditions necessary for the efficient production of this film on the surfaces with which you have to deal; you would also investigate its use by some great industry where the kind of surface, the exposure of this surface and the conditions of application have some bearing on your own problem.

In spite of many secondary dissimilarities the problem of the automobile producer is not unlike your own. You both want durability, ease, speed and certainty of application, good appearance, ease of cleaning, and convenience and speed in the repairing of scratches or bruises.

Some of you are now confronted with difficulties which may seem almost unsurmountable. The automobile man was in this same situation about two years ago. You are hampered by inadequate shop facilities while he has almost forgotten that he, too, had to make changes in his plant in order to insure efficient application. Your labor objects to strange new smells; the automobile spray-man today even in poorly ventilated shops, thinks no more about the smell of lacquer than a painter thinks about the smell of linseed oil. You object to the necessity of particularly thorough surface preparation; but this requirement was an even greater hardship for the automobile finisher, as he works on curved irregular surfaces and must nevertheless turn out a more highly finished surface than is necessary on railroad cars. You are troubled with chipping around rivet heads; he used to be troubled by chipping around attached mouldings. Striping and many other details have had to be worked out along new lines. You may have experienced many difficulties that he has escaped but you will escape many that he has had to overcome. Of all applications of lacquer there is probably none possessing greater economic advantages than its use on sand blasted steel surfaces.

The automobile industry has not made this effort because of any stupid, unselfish, determination to help the struggling lacquer industry. No business in the country is as cold, calculating and competitive as the motor car business. A bad decision or a good decision made too late can easily spoil a year's business. The motor manufacturer first wanted lacquer because its use made his production faster and more positive but as soon as a few makes came out in lacquer the public began to insist on it because of durability, appearance and easy, fool-proof cleaning. Some automobile companies have already had good reason to regret their procrastination in adopting it.

Public favor is not an important factor in your case. While production speed, inventory tie-up and floor space are all more important to the motor car producer than they are to you, and resistance to sulphur fumes and to the high temperatures of some parts of a locomotive surface are secondary advantages that do not attract him, the fundamental advantages are about equally useful to both industries.

Your careful study of the use of lacquer by motor car manufacturers and refinishers will bring out far more completely than I have outlined, the points of resemblance and difference, the respective advantages and disadvantages peculiar to their industry and to your own. You will now be ready to investigate the experiments with lacquer made by railroads and car builders. If you are already familiar with modern automobile practice and results you will be better able to make proper allowance for the inadequate facilities, uncertain technique, high cost and mediocre result that has naturally characterized much of this new work.

What the railroads use lacquer for

In order to get some idea of what the railroads are doing with lacquer, a questionnaire on the subject was sent to 20 of our representative lines. The 20 were chosen by a man who knew something about railroads but nothing about lacquer.

Two out of these 20 roads are using no lacquer on their equipment either experimentally or otherwise. My further remarks, in this connection, will apply only to the remaining 18 companies. One company, which began experimenting in 1924, has recently standardized on lacquer for outside finishing on all passenger equipment and locomotives. One railroad began its experiments in 1923; five in 1924; six in 1925, and the remaining six during this year.

The 18 companies who use lacquer have applied it to approximately the following equipment:

Sleeping cars—399, of which 25 were lacquered inside as well as outside.
Passenger coaches—255 (18 lacquered inside also)
Baggage, mail and express cars—13
Dining cars—5
Horse express cars—10
Gas-electric motor cars—5
Observation cars—1
Passenger locomotives—284
Freight locomotives—880

This gives a total for these eighteen roads alone, of 1,164 locomotives and 688 cars. Several of these 18 companies say that their work is still practically in an experimental stage; some of them add that the outlook is favorable.

Advantages and disadvantages

These companies were also asked to state what they considered the principal disadvantages and advantages resulting from the use of lacquer. I have drawn up two lists giving these points in their order of importance as shown by these questionnaires.

The disadvantages are as follows:

1. Need for new shop facilities and equipment.
2. Cost of material.
3. Odor during application.
4. Difficulty of application.
5. Necessity for special surface preparation.
6. Difficulty of lettering and striping.
7. Chipping around rivet heads.
8. Fire hazard.
9. Trouble with labor.
10. Difficulty of cutting in on group repairs.
11. Chalking on exposure.

The advantages in the order given:

1. Speed of drying.
2. Durability.
3. Less total cost.
4. Easy to clean.
5. Better appearance.
6. No baking equipment or process required.
7. Easy to repair scratches, bruises, etc.

I will not dwell too long on a comparison of these two lists, but will merely point out that the objections have more to do with conditions surrounding application than

with the final results. The stated advantages, on the other hand, constitute really a list of most of the fundamental advantages inherent to lacquer. Given adequate facilities, intelligent supervision and a few months' experience, all these comparative disadvantages would diminish. They have largely disappeared in the automobile industry. In proportion as the difficulties decrease so will the advantages increase.

If in an industry as great and as old as the railroad business in this country and in Canada, there happen to be some compnies in which buying has come to be done on a basis of friendship rather than merit, this would not be surprising. These few companies will undoubtedly, if they make any experiments at all, find that lacquer is very unsatisfactory, and decide to continue with the materials they have been accustomed to using. It is no trick at all to get bad results with good lacquer when good results would be unwelcome.

Perhaps you have guessed that I have much confidence in the future development of lacquer and in the advantages that go with its use. But let us be quite honest and admit that the good things of this world are not acquired without effort. If a fair investigation of all the factors leads you to the conclusion that lacquer should be given a fair trial, be prepared to spend money and effort and above all to keep an open mind. The period of transition will be hard in some cases but I predict without hesitation that you will all have passed through it before many years have gone by.

Discussion

One member questioned the advisability of spraying locomotives, for example, with lacquer at the same time that oxy-acetylene welding or cutting torches are being used in the vicinity, owing to possible fire hazard. This member also asked if the odor of lacquer is seriously objectionable to workmen. Mr. Orr replied that lacquer vapors are inflammable and certain precautions must be used. He said that while not wanting to minimize the fire hazard, the possibility of danger in using lacquer has probably been exaggerated and is not appreciably greater than that involved in the use of other finishing materials to which railroad men are accustomed. Regarding odor, it may take longer for men to get accustomed to the smell of lacquer than to the smell of some other materials, but there are many shops in the country in which lacquer has been used day in and day out for years. Men have ceased to notice it and none have suffered ill-effects.

Another member asked about cleaning, and Mr. Orr replied that experience with the cleaning of lacquer proves it to be much easier, cheaper and quicker to clean, particularly if polished, than any oleoresinous surface. The question of polishing was raised and its advisability considered doubtful. Regarding the brushing of lacquer, two years ago this would have been considered impossible owing to its quick-drying properties. By using materials which delay the drying, however, practical brush lacquers have been developed. On wooden coaches special lacquer must be used with greater possibility of film stretch than is needed on steel equipment. There has been less advancement in this particular type of lacquer than in that suitable for use on steel. Subsequent discussion regarding the application of lacquer over old material developed that this is permissible providing the adhesion of the original material is still sound. Owing to the possibility of trouble, however, it is safer to remove the old material. Questioned regarding the durability of lacquer, Mr. Orr replied that given equal thickness and a good job in each case, lacquer has greater resistance to abrasion.

Speeding up the testing of triple valves

By J. C. Coyle

A CONSIDERABLE saving of time, in testing the air on cars at the Denver shops of the Denver & Rio Grande Western, is made by using the device shown in the illustration. The ordinary procedure in testing air was to attach the gage first to the triple valve exhaust

The testing of triple valves may be speeded up by the addition to the gage of a short section of hose and a pet cock and connection

port, then to the retainer pipe. By the addition to the gage of a short section of hose and a pet cock and connection, it is connected to both the retainer and the triple valve exhaust port, the former being tested by opening the pet cock, and the latter with it closed.

No lead poisoning at Pullman works

THE February issue of the Pullman News contains the following interesting quotation from Dr. A. M. Johnson, engineer of tests, on the way dangers from lead poisoning of painters has been practically eliminated at the Pullman car works:

"Years ago we realized the necessity of devoting special attention to our painters as, when much lead gets into the system, a painter gets plumbism, commonly known as lead colic. This is acquired chiefly by a painter eating food without thoroughly washing his hands, or by inhalation of the paint dust when sanding a painted surface. About 1911 we made changes in the white lead used and this greatly lessened the toxic effect, and we also installed excellent sanitary equipment and supervision and regular medical inspection. All this caused a phenomenal reduction in lead poisoning. For instance, during the first six months an average of 489 men was examined monthly and 109 cases of plumbism found, or an average of 18 a month. During the next two months an average of 649 examinations was made and 16 cases found, an average of 8 a month. During the next 13 months (during which the paint changes and sanitary and medical supervision were well developed) an average of 639 men was examined monthly and only three cases found. Thus the

lead poisoning fell from an average of 18 a month in a force of 489 men to 3/13 cases among 639 men employed at the Pullman works.

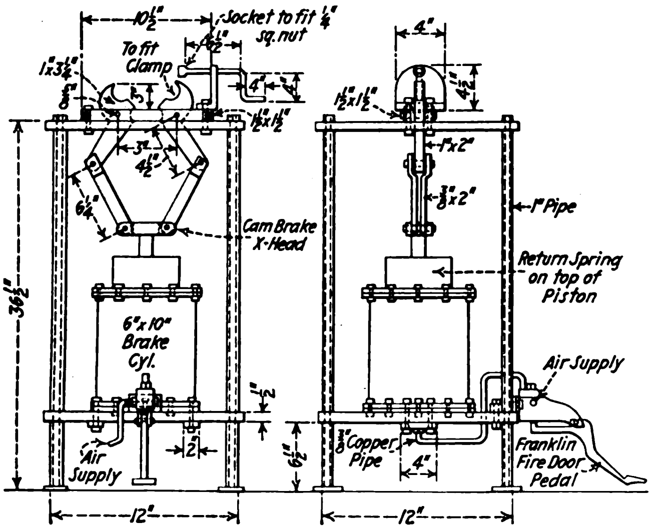
"In recent years a paint pigment known as titanox has been produced, which we successfully experimented with as a possible substitute for white lead, the basis of our interior paint and, because of the necessity of sanding inside paint to prepare suitable surfaces for finishing, the main danger of lead poisoning. In some respects the new pigment was even superior to white lead, and a change in standardization of ceiling enamel was a result. Later its use was standardized in all the ground colors, both walnut and mahogany, which furnish the foundation paint system on the interior of cars preparatory to the graining and varnishing. So we have, practically speaking, eliminated lead from our interior painting, which was our chief source of lead poisoning.

"The paints used on the outside of the cars are not on a lead base, and what little lead may be there offers practically no liability of poisoning, since there is no dry sanding. The only rubbing done is on the first three coats of the so-called surfacing, and this with rotten stone and water, which produces no dust.

"In the steel erecting department, where the steel framing of the car is assembled, it was the practice of many years to use red lead for sealing joints and abutments to prevent corrosion. A high grade iron oxide paint is now used, thus eliminating any poisoning possibility here."

Air hose clamping machine

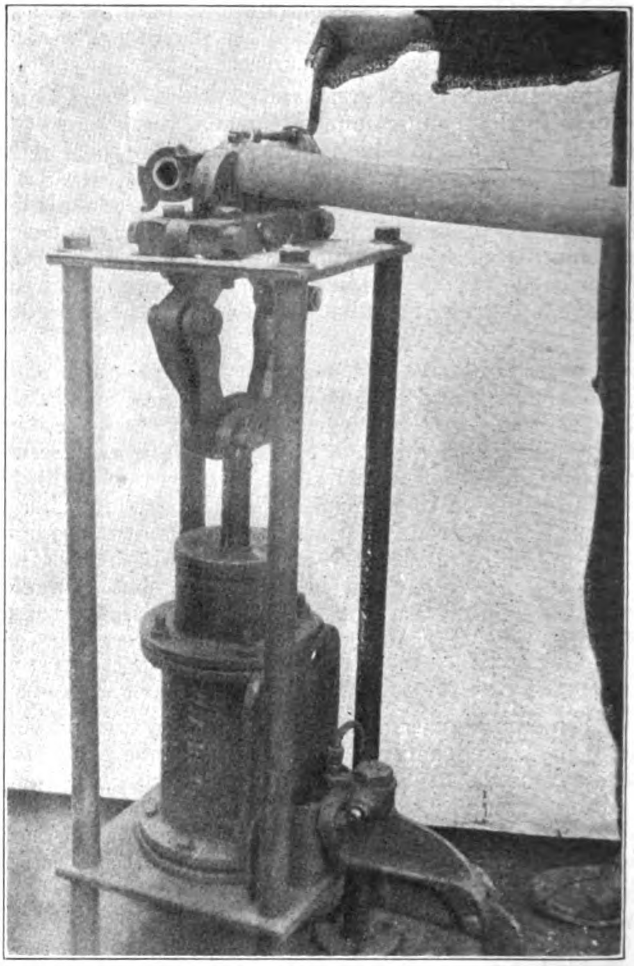
In fitting up air hose one of the most important operations is quickly and securely to apply the clamps and bolts. Under the old methods the operation was handled at the rate of from 15 to 20 hose per hour, but due to the yearly increasing business and the study given



Details of the air hose clamping machine

to all the operations in the repair shops, the air brake department of the Emerson shop of the Aalantic Coast Line designed the simple machine shown in the illustrations with which 60 air hose per hour can be properly clamped and bolted.

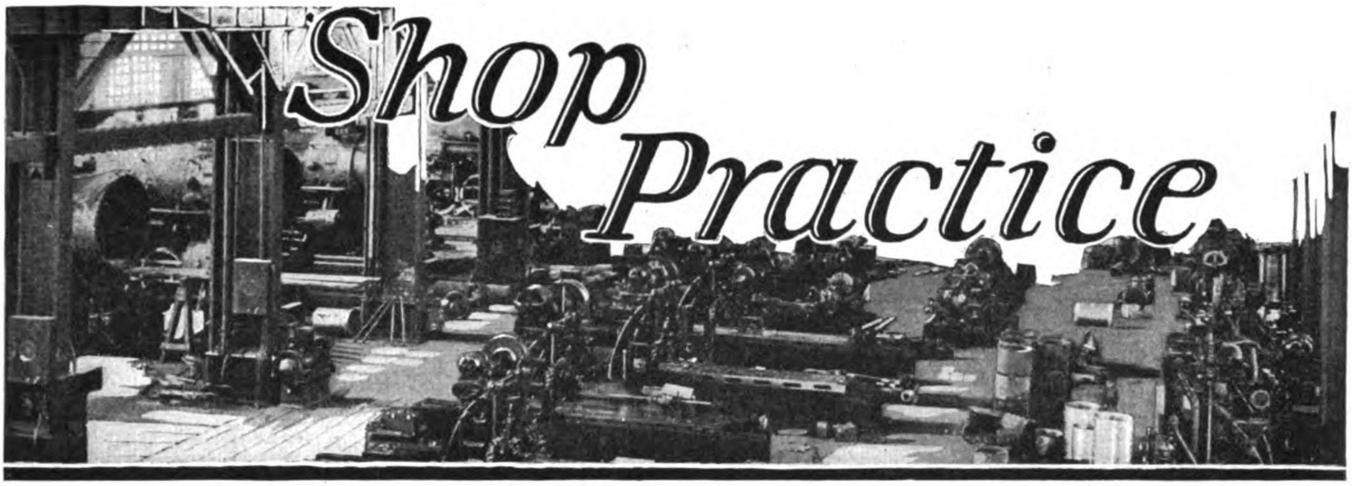
The clamping is done by a scissors type arrangement with jaws that fit around the clamp. A 6-in. air cylinder, operated by a foot pedal furnishes the power. When air is admitted, the piston in the cylinder moves upward which causes the jaws to come together, closing the clamp uniformly around the air hose and leaving free the ends of the clamp for application of the bolt. A small hand operated crank socket is attached to the machine close to one jaw by which the nut is quickly run up and tightened.



With this device 60 air hose per hour can be clamped and bolted

The description of this device was furnished through the courtesy of the Atlantic Coast Line News.

Scrap couplers at the Falk Corporation's plant, Milwaukee, Wis. The pile is estimated to weigh 4,700,000 lb. and contains 23,500 couplers. Their scrap value is $36,000

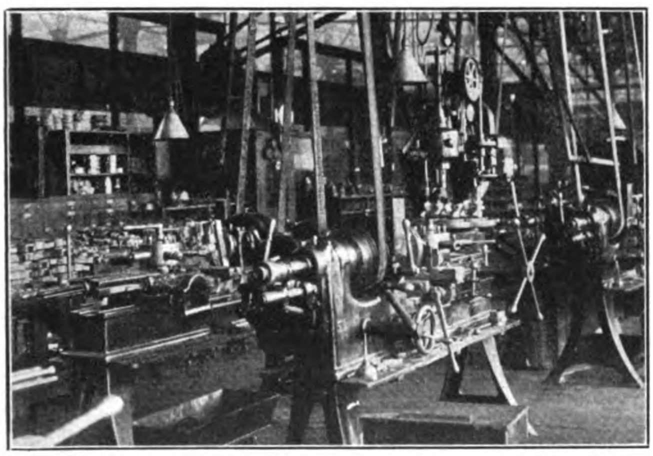


Brass and air brake departments of B. & M. Billerica shops

Equipment and method of handling and inspecting work—Operators do not have to sharpen tools

By J. Murray Cairns
Foreman, Boston & Maine, Billerica, Mass.

THE Billerica shops are the principal locomotive repair shops of the Boston & Maine. Practically all of the classified repairs on the system's locomotives are made at this point. In addition, the machine shops manufacture and repair locomotive parts for all points on the system. Thus, the brass and air brake departments at these shops are required not only to handle work originating in the locomotive erecting shop, but must repair, on shop orders, brass and air brake parts for all other small shops on the system.

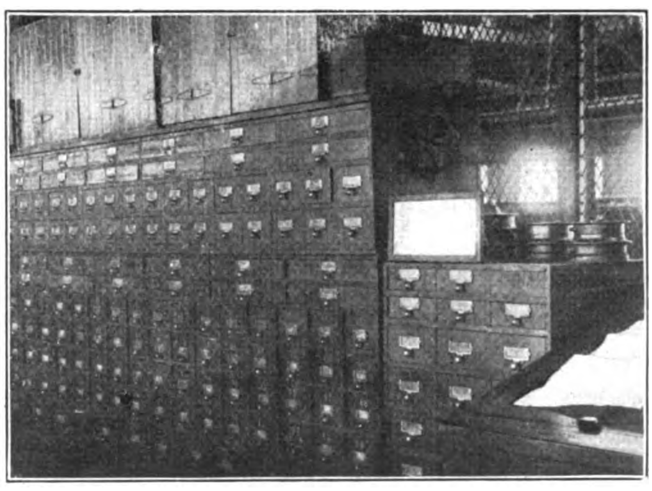


Some of the turret lathes for turning brass parts

This department, which occupies a floor space of 150 ft. long by 40 ft. wide, is on the balcony located in the locomotive repair shop. A 1½-ton monorail electric crane runs the length of the department. The following machine tools are provided for handling the work:

No.	Size	Type	Manufacturer
		Brass work	
4	16 in.	Turret lathes	Warner & Swasey
2	18 in.	Turret lathes	Warner & Swasey
1	18 in.	Turret lathes	Foster
1	Small	Vertical drill	Prentiss
1	36 in.	Vertical drill	Baker Bros.
1	No. 50	Internal grinder	Heald
1	No. 55	Internal grinder	Heald
		Air brake work	
1	18 in.	Lathe	Prentiss
1	16 in.	Lathe	Prentiss
1	36 in.	Boring mill	Bullard
1	8 Spindle	Angle cock grinders	Turner (Horizontal)

Ample room is provided for test racks, work benches,



The tool cabinet which contains 156 drawers in which sharpened tools are kept for each part to be machined

tool cabinets and portable material trays. This department is supervised by one foreman, one assistant foreman and two piecework inspectors, under whom are 27 machinists, three machinist helpers, one laborer and one messenger, or a total working force of 31 men. With this equipment and working force, the following output has been obtained:

Air compressors repaired during 1925

Size	No.
9½ in.	1,051
11 in.	24
8½ in. by 8½ in.	47

Other locomotive parts repaired from July 1, 1925, to January 1, 1926

Item	No. Repaired
Triple valve (engine and tender)	89
Distributing valves	314
Feed valves	1,193
Brake valves	308
Fire door cylinders	167
Angle cocks	2,939
Safety valves	1,146
Lubricators	158
Steam and air gages	1,198
Inspirators	463

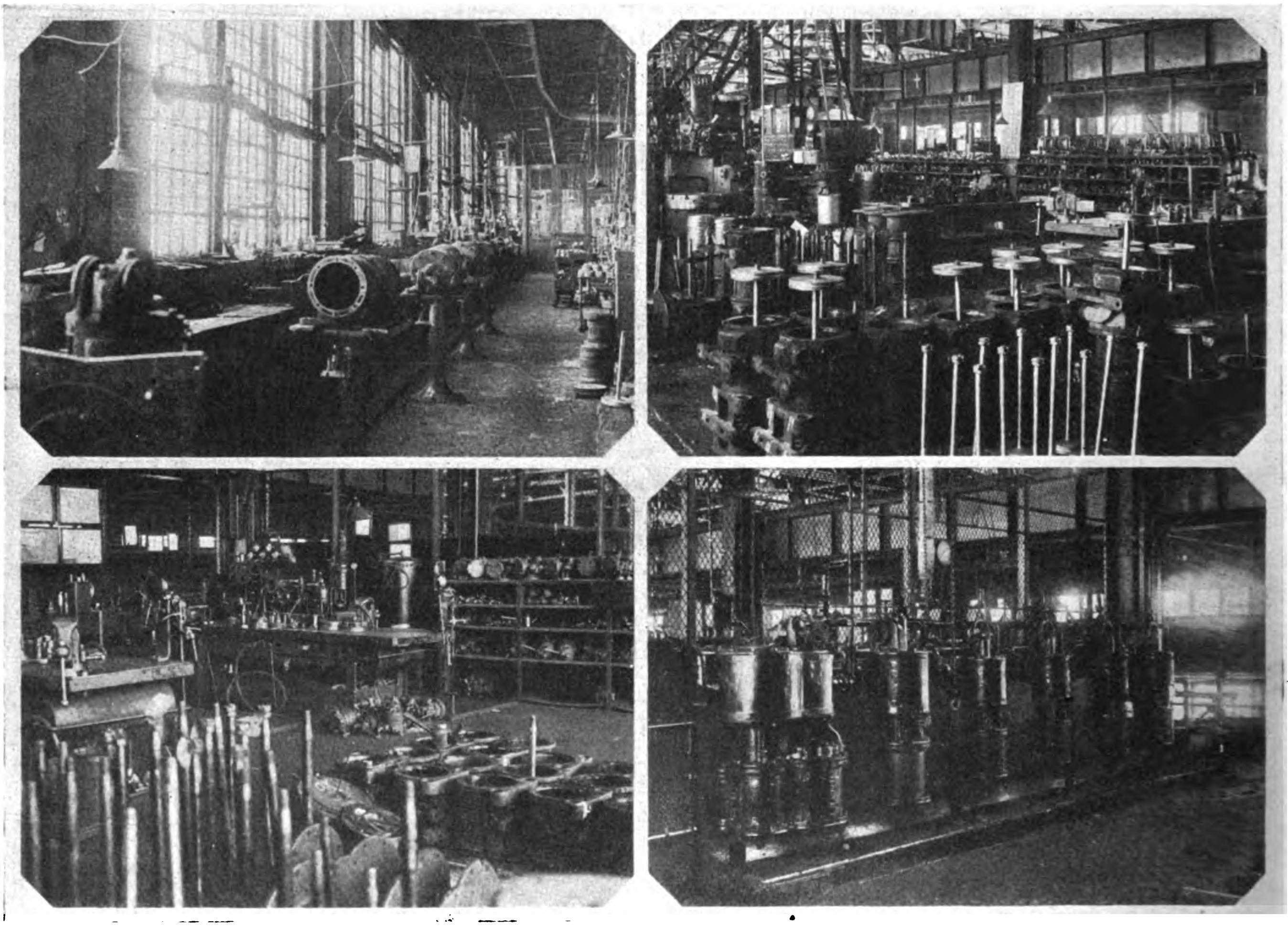
Repairing locomotive fittings

When the locomotive fittings are stripped from the locomotive, they are tagged with tin tags and placed in a steel box 16 in. by 20 in. by 36 in., which is large enough to hold the equipment of any locomotive. The box is delivered to the floor under the balcony where it is lifted to the brass department by a monorail crane. Here the parts are separated and those which require cleaning are sent to the cleaning vat where they are boiled and rinsed.

The cleaning vat, which holds about 300 gallons of cleaning solution, is divided into a boiling and rinsing compartment. The first is 6 ft. by 4 ft. by 4 ft., and the latter is 4 ft. by 4 ft. by 4 ft.

When the cleaning solution is made up with caustic soda, two ounces per gallon are used, and when made up with Oakite cleaning compound, 4½ oz. per gallon are used. The solution is heated by steam coils. The vat is cleaned out about every 15 days, depending on the condition and the number of parts cleaned. The parts are allowed to remain in the cleaning solution from two to three hours.

After the parts have been cleaned, they are placed in boxes on a shelf until they are ready to be repaired.



Upper left—A line of air compressors mounted on adjustable work stands; Upper right—A general view of the air compressor repair department; Lower left—A corner of the air brake department, showing the testing rack; Lower right—Air compressor testing rack

As such parts as lubricators, safety valves, whistles and air brake valves are repaired, they are placed on separate shelves, as shown in one of the illustrations, ready to be delivered to the locomotive. As soon as those parts, necessary to be on a boiler are tested and repaired, they are delivered to the locomotive.

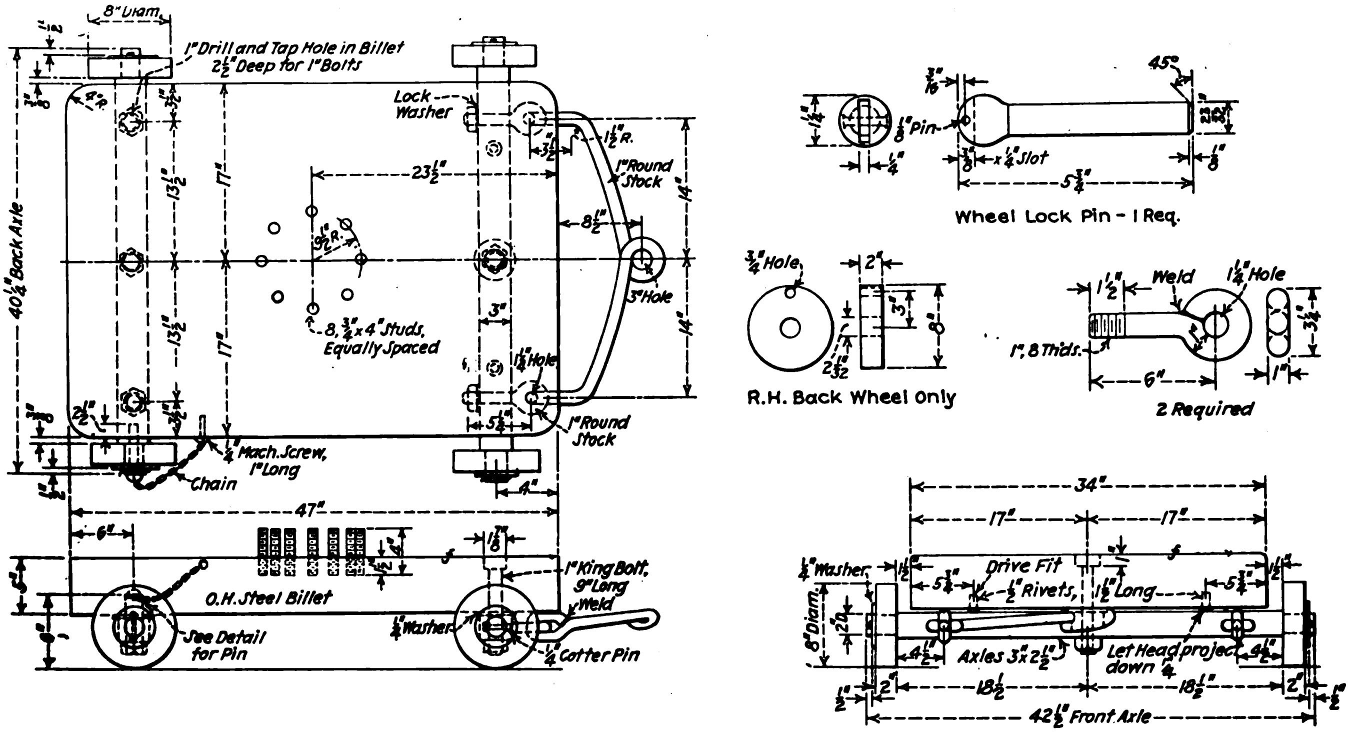
Each repair man keeps a book record of all work done on such parts as injectors, lubricators, safety valves, whistles, cab valves, air compressors and brake valves. This record shows the time the part was delivered to the repair bench, what locomotive it is for, the time it

is scheduled out and the time the part was repaired ready for delivery. With this record, it is an easy matter to check up defective repair work where more than one man is working on the same class of work. It also helps to settle disputes with other departments as to whether work has been finished and delivered.

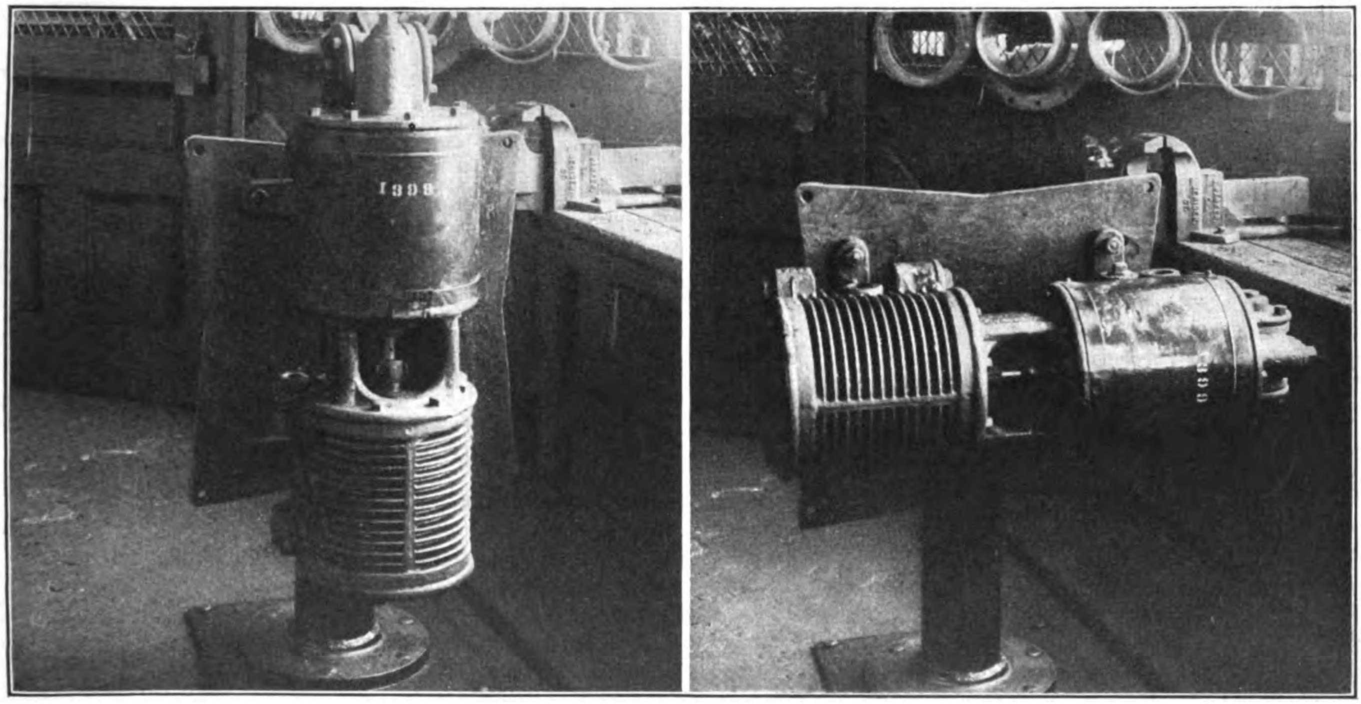
The repairmen working on the principal jobs, such as mentioned above, every Monday morning are given a revised schedule for the week. This schedule is based on the master schedule kept in the locomotive repair shop. Every Friday the foreman checks up with each man as to the schedule given. Under this system the work is always ahead of the other departments.

Piecework inspectors

There are two piecework inspectors who are responsible for the quantity and quality of the work turned out. These men are under the general piecework inspector and co-operate with the foreman and assistant foreman in the various departments to which they are assigned. Their duties principally consist of making out all of the piece work and day work time



Details of truck used for hauling the Worthington feedwater heater about the shop

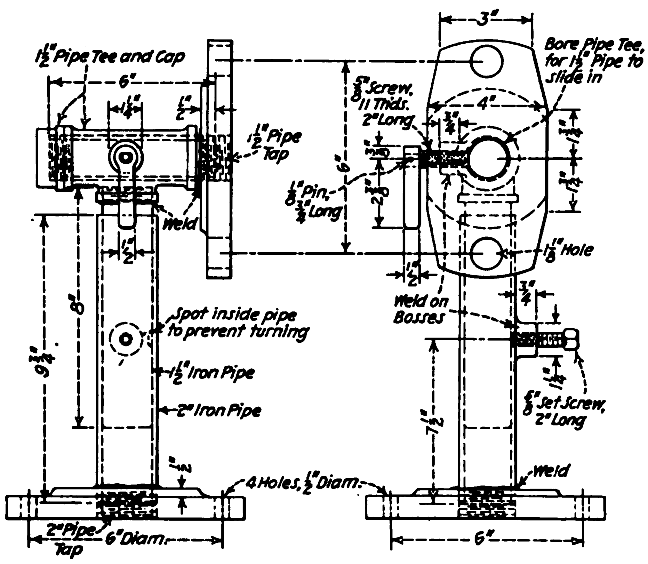


The revolving air compressor stand in the vertical and horizontal positions

cards and of inspecting the finished work. They use limit gages for this work mostly of the plug type. All the work rejected by the inspectors is checked up by the foreman and, if found wrong, the operator is held responsible.

Method of handling brass castings

All standard brass castings are finished on a shop order and delivered to the stores department for distribution at other points on the system. When the castings are received from the stores department, they are separated and put into traveling trays, such as shown in one of the illustrations. These trays are lined up at one end of the department until ready for the operator. Usually the assistant foreman keeps two or three jobs ahead of each turret lathe. The trays are wheeled to the machine with the necessary tools to do the job. These tools are kept in a cabinet, sharpened ready for use. The operator is also furnished with a blueprint of the job. The blueprint is mounted on stiff cardboard and then shellaced. The work order is hung on the machine for the inspector's information. The finished



A work stand for holding lubricators

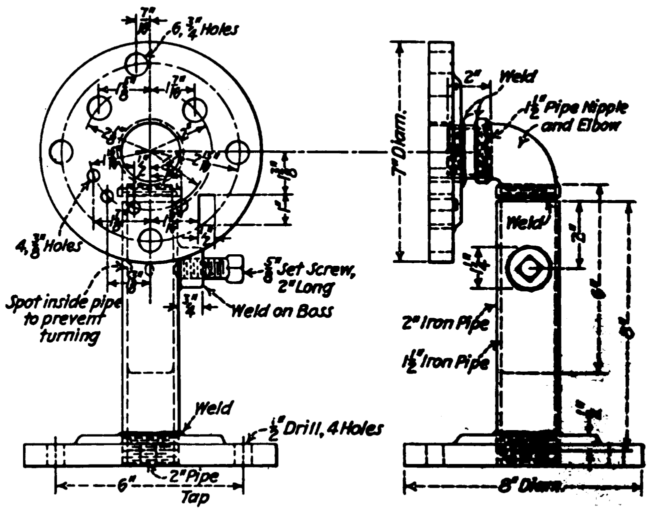
castings are shipped to the stores department every day at 3 p. m. After the operator has finished a certain job, the tools are taken to a designated place where a machinist is assigned to inspect, sharpen and place them in the proper drawer in the tool cabinet. With this system, the operator does not have to keep his tools sharpened and, furthermore, if a tool is not properly sharpened, the responsibility can be quickly placed.

The tool cabinet is divided into 156 drawers, each one holding the necessary tools for machining a certain part. A sample of the part to be machined is in each drawer. Each drawer has a brass plate above the handle, numbered and lettered with the name of the part for which the tool is to be used. The drawers are numbered in rotation, and any tool, or tools, can be easily found by consulting an alphabetically listed index chart which is in a frame at one end of the cabinet.

A show case, 6 ft. by 4 ft., which contains samples of all the brass parts machined in this department, is conveniently located in the shop. The samples, which are polished and lacquered, have a pattern number stamped on them. These sample castings have proved very convenient as there are always questions arising about them and when they do, we have them right at hand.

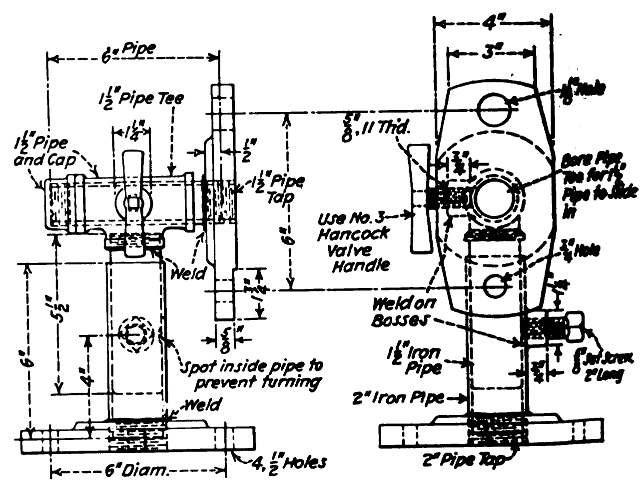
Repairing air brake parts

Practically all of the air compressor repair work for the system is handled at this shop. All compressor cylinders which have to be ground are stripped from the center casting and sent to the cleaning vat where they are thoroughly boiled and cleaned. They are then sent to the grinders. After the compressors are assembled, they are tested out by air on assembling stands, from



A distributing valve work bench stand

which they are sent to the steam testing rack where they are again tested and allowed to run for a designated time. When the pumps are applied to the test rack, they are painted with a spray machine, which requires about five minutes for each compressor. By the time the compressors are tested, the paint is dry, after which they are stencilled with the engine number and placed in storage until the time they are to be delivered to the locomotive. The test rack will hold one 8½-in. by 8½-in. one 11-in. and four 9½-in. compressors.



Brake valve repair work bench stand

The air brake valves are handled in a manner similar to the brass valves and car equipment, only they are lined up at the other end of the department. An effort is made to keep everything in its own place.

Air pump assembling stand

The framework of the air pump assembling stands is made from a piece of 6-in. iron pipe, with a flange

riveted to a square piece of ½-in. boiler sheet which is bolted to the floor. The table and plate, which revolves on ball bearings, is bolted through the pipe by one bolt. Below this bolt is a pin or dog, with a spring to which a handle is attached. Four holes are drilled in the plate for the pins to enter, making it possible to work at the compressor in four different positions. In order to change the position of the compressor on the stand, it is only necessary to pull out the handle and turn the table until the pin strikes the next hole in the plate.

Lubricator stand

The purpose of the lubricator stand is to enable the workman to get at the lubricator in any position. It is made entirely from pipe and scrap castings. The lubricator is bolted to a stand which is made from a scrap air compressor piston head. The base is tapped for a

The top view shows the finished parts and the schedule board and the lower view shows the traveling work trays, repair bench for steam gages and the tool cabinet

2 in. pipe, into which is screwed a piece of 2-in. pipe 9¾ in. long. Inside of this pipe is a piece of 1½-in. iron pipe, on the end of which is screwed a 1½-in. pipe tee with a cup on one end, the other end taking a piece of 1½-in. iron pipe the length of the tee, which in turn is screwed into the casting on which the lubricator is bolted. About midway on the main piece of pipe is a bronze welded boss which is tapped out for a set screw with a tee handle attached to locate the stand in any vertical position. Another boss is welded on the side of the pipe tee, with a set screw and handle inserted for turning the lubricator around to different positions.

The distributing valve and brake valve stands shown in the accompanying illustrations are made in the same way, only to suit different types of valves.

Avoiding delay when a valve gear breaks

A valve motion has not yet been designed that will not, at times, develop a defect that will cause a failure of some of the many parts, but with the Walschaert gear properly maintained, failures are

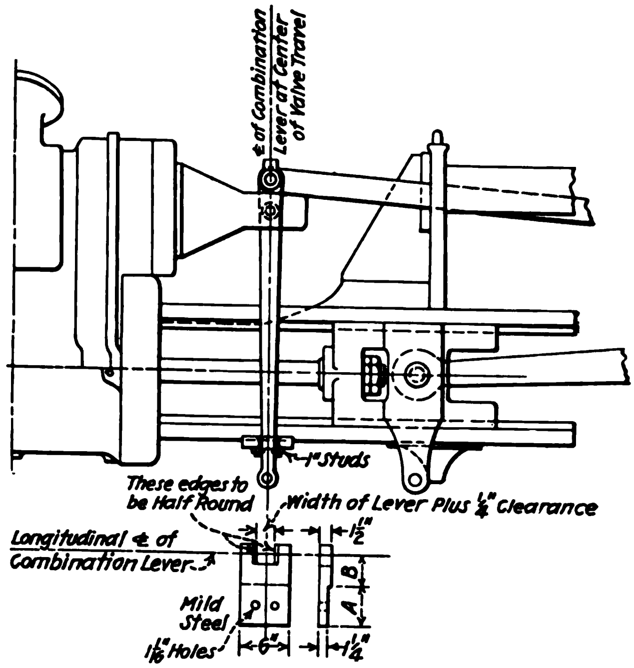


Fig. 1—Forged bracket attached to the bottom guide bar to hold the combination lever central

reduced to a minimum, and even with the breakage of some part it is possible in nearly every case to come along without disconnecting one side of the locomotive and still

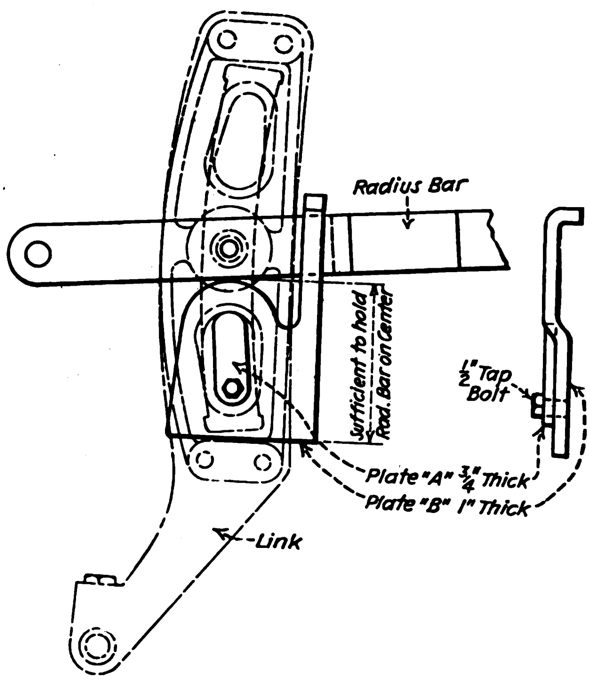


Fig. 2—Plate used to block the link in case of a failure

getting more than half power without the possibility of getting on the dead center.

The accompanying illustration is from suggestions

worked up in the Wilmington, N. C., shop of the Atlantic Coast Line, which, when used on actual trial, gave good results.

Fig. 1 of the accompanying illustrations show a forged bracket attached to the bottom guide bar either with studs or cap screws. This bracket merely holds the combination lever central when defects occur in the crosshead bracket, connecting link, or any pins used with these parts. The bolts for application of this bracket, should be put in at the shop and the bracket carried with other equipment, for an emergency.

When the combination lever is held in the position shown and the other parts are disconnected from the crosshead, the eccentric will give sufficient port opening to handle any ordinary train without the lead opening which is not obtained under these conditions.

Fig. 2 shows a plate used to block the link in case of a failure in the eccentric crank or rod. After removing the parts and disconnecting the lifting arm from the reverse shaft, apply the plate to the link, which will hold the radius bar in its central position. Then, with all the parts in operation from the crosshead, the port opening will be the amount of the lead opening of the valve. This is perhaps not enough to handle much more than half the capacity of the locomotive, but it will make unnecessary any disconnecting on the disabled side with the possible attendant difficulty of getting on dead center.

The information contained in the article was taken from a recent issue of the Atlantic Coast Line News.

Bronze-welding copper*

MUCH has been written about the welding of commercial copper in its various forms. Lately this problem has been investigated from a relatively new angle and with success. Stated briefly, the latest American practice recommends that copper work requiring high strength, unity of composition and high ductility, be done only on specially deoxidized copper for a base metal. It is now possible to purchase such copper, deoxidized with silicon, manufactured with the view of giving it the best welding qualities.

Starting with this base metal, the welding is done with a special copper rod containing silicon, using a neutral flame. The work is carried on quickly at the lowest possible temperature for satisfactory fusion. Silicon in the welding rod protects the base metal from undue oxidation. This practice, carefully followed out and supplemented where possible by annealing or hammering, or both, gives a weld that is satisfactory in all particulars.

For much copper work, such as repairs on existing equipment, or the use of stock sheets, metal deoxidized with silicon is not available. Many coppersmiths, maintenance men and steamfitters have found that a joint, tight and strong enough for most purposes, can be made in ordinary stock copper with bronze welding rod.

The technique for bronze-welding copper pipe, copper castings, and copper sheet, is almost exactly the same as bronze-welding on steel or on cast iron. The parts to be joined are put into contact and must be heated to a temperature which will show red in the daylight, or just to the point where bronze will unite with the base metal, and a tinning layer of bronze is flowed on. Brazo flux is used freely in applying this first layer of bronze. After a surface has been tinned, bronze is built up on it to a proper thickness and width for the required joint. This work can progress along the seam in sections, tinning and building up 2-in. stretches one at a time.

On copper castings and material over ⅛-in. thick, it is best to bevel the edges. Welding is then done in the same way as described above. Considerable care must be used to see that the tinning coat is carefully and thoroughly applied to the bottom of the joint. The work should be completed as rapidly as possible, and with a minimum of heat. Special care should be taken not to heat the copper any further back from the weld than necessary. To provide for this last factor some oxwelders build up ridges of wet asbestos cement along the weld, far enough back so that these will not interfere with the work. If these tend to dry out they can be kept wet by adding water from time to time.

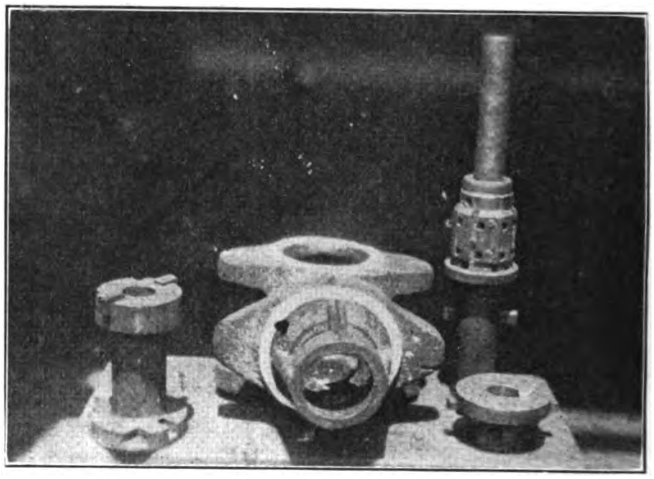
*An abstract of an article which appeared in the August issue of *Oxy-Acetylene Tips*, published monthly by the Linde Air Products Company, New York.

Special tools for machining tank valve bodies

By J. H. Hahn

Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

THREE special tools that can be used to good advantage for machining cast iron tank valve bodies are shown in the accompanying illustrations. They are of the inserted blade type made of high speed tool steel with bodies of carbon steel. The tools are designed for use on small turret lathes, boring mills or engine lathes. When used in an engine lathe the tool is placed in the tail stock and the tank valve body is chucked in the lathe in the usual manner. The tool is fed into the work with the tail stock as is done when drilling a hole on the lathe. One operation at a time is handled in this manner.



Special tools for machining tank valve bodies

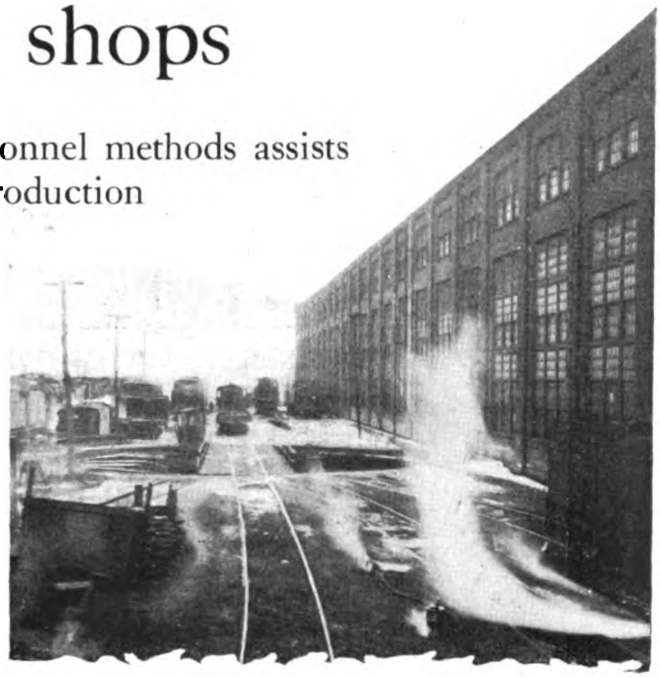
For example, a lot of 25 tank valve bodies is to be machined. We will put in the tool for facing one side and complete this operation on all 25 of the castings, then remove this tool and put in the one for facing the top and machining the seat. This operation is completed on all 25 of the seats, after which this tool is removed and the tool for finishing the tank valve bodies is put in place. The third operation completes the tank valve bodies. When using turret lathes or small boring mills the operations are about the same.

These tools are easily constructed in the average tool room.

Lehigh Valley has well organized system shops

Efficient application of modern personnel methods assists in obtaining increased production

Part I



Turntable at the entrance to the locomotive shop

THE recent controversy between the followers of Bill Brown and Top Sergeant in these columns, showed that there are still a number of mechanical department men who are skeptical as to the results that can be accomplished through the application of modern personnel methods. For some time the *Railway Mechanical Engineer* has felt that perhaps the most convincing argument in favor of the utilization of modern personnel methods would be to publish a description of the operation of some shop in which real results were being obtained through a well planned organization and administration of the shop forces. Considerable space has been devoted in these columns to the subject of foreman and apprentice training, among the examples cited being the system shops of the Lehigh Valley, Sayre, Pa., where an established policy of personnel and employee welfare work has been in operation for a number of years.

In order to get a complete picture of the system of operation at the Sayre system shops, a brief history of the development of personnel work on the Lehigh Valley should be given. In December, 1920, a short time after the railroads were returned to their owners by the government, E. E. Loomis, president of the Lehigh Valley, came to the conclusion that more care should be given to the selection of new employees and in preparing them for and installing them in their new jobs. Also, that these men should be followed up and a system of service records developed for each man in the organization.

The rod department is shown in the foreground—the turret lathe and air brake departments are located near the entrance shown in the background

There are seven operating divisions on the Lehigh Valley and one man was selected from each division to report to the division superintendent and devote all of his time to the personnel question on the division. These men were given the title of supervisors of employment and they are held responsible for the careful selection, placement and development of the new employees. Of course, the object of this work is to reduce labor turnover and the resultant expense, cut down the number of mistakes and the amount of damaged work, reduce the number of injuries caused by inexperienced men and give the employees a greater sense of security. The desire of the management is that the workers be satisfied.

Employee representation

About 25 per cent of the employees of the road, or 30 per cent of all operating department employees, are in the shop crafts. In 1922 the shop crafts employees formed "The Association of Maintenance of Equipment Employees of the Lehigh Valley Railroad." This includes all of the gang leaders, mechanics, helpers, apprentices, etc., but not the supervisors. A local committee (division or general shop) is formed at each point by electing representatives from each craft on the basis of one committeeman for the first 49 members, two for 50 to 200, three for 201 to 300, etc. Candidates for these positions are nominated on the first Monday in May and an election by secret ballot is held on the third Monday of that month. Nominations are made by petition, which must be signed by 25 voters or 25 per cent of the voters in the craft in the election district. The local committeemen elect their own division or general shop chairman.

A general system chairman representing all maintenance-of-equipment forces is elected for a term of two years by the local chairmen of all crafts; general system craft chairmen of each craft are elected for a term of two years by the local chairmen of each craft. The general committee is composed of the general chairman and the general craft chairmen.

All grievances must be acknowledged and disposed

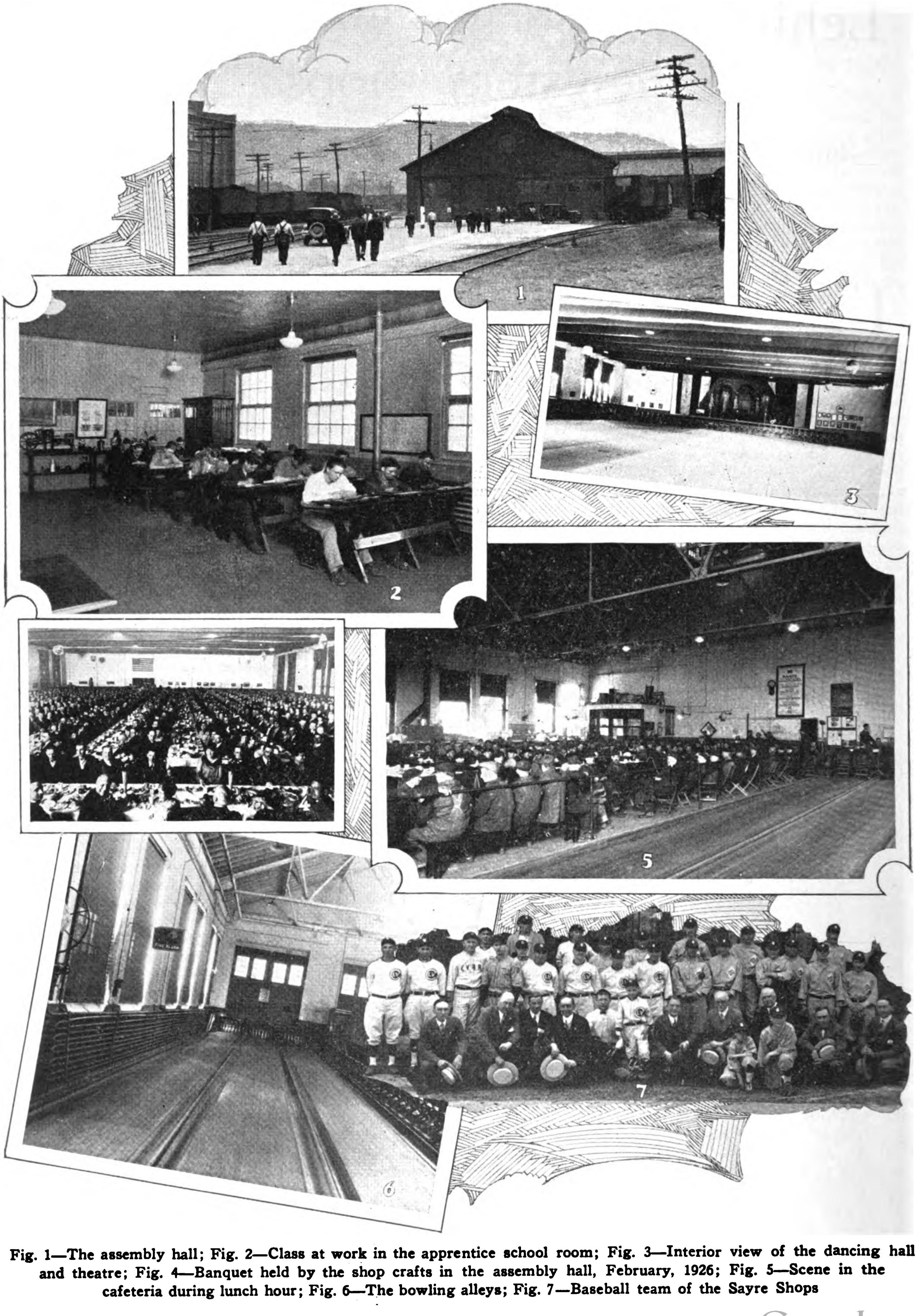
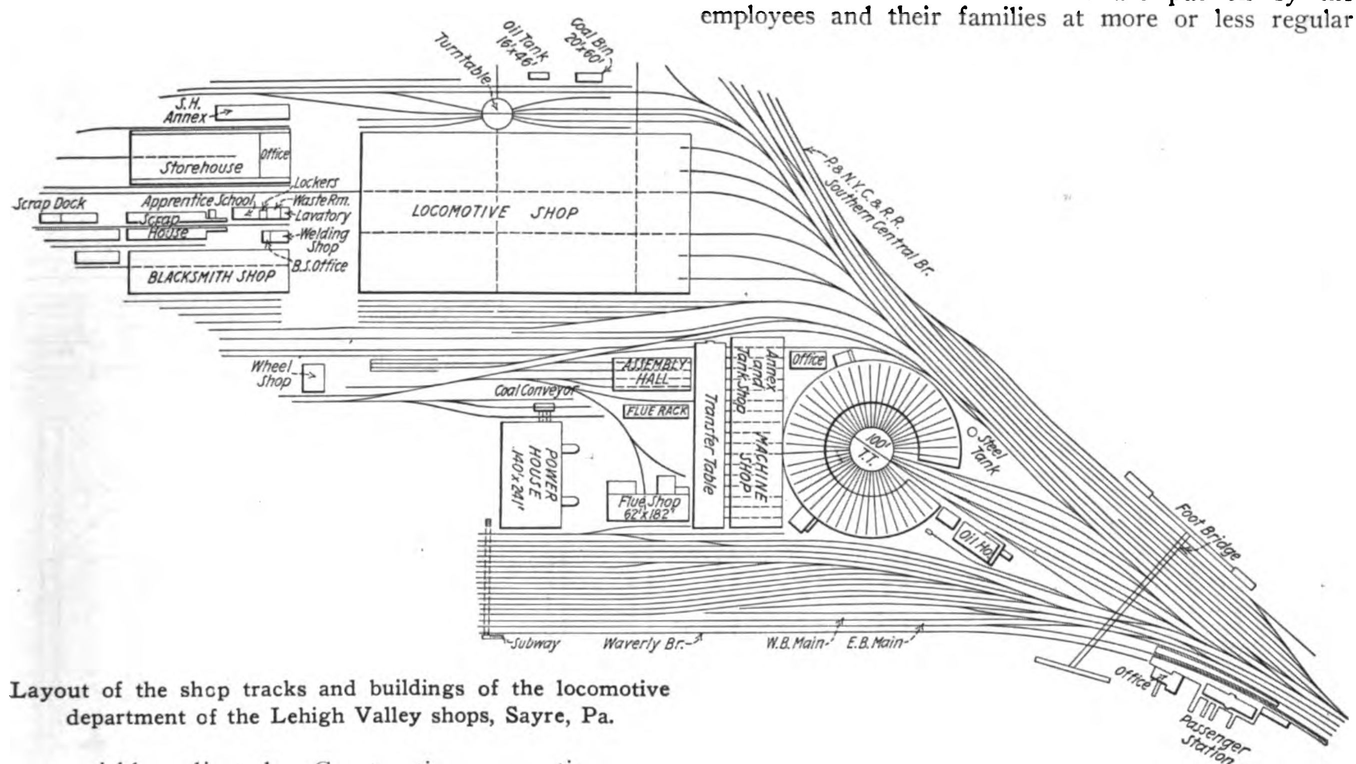


Fig. 1—The assembly hall; Fig. 2—Class at work in the apprentice school room; Fig. 3—Interior view of the dancing hall and theatre; Fig. 4—Banquet held by the shop crafts in the assembly hall, February, 1926; Fig. 5—Scene in the cafeteria during lunch hour; Fig. 6—The bowling alleys; Fig. 7—Baseball team of the Sayre Shops

of by a general foreman in seven days and by a master mechanic or shop superintendent in 10 days. Questions which cannot be settled by the local committees and the local officers are referred to the general committee for decision. If for any reason the general committee cannot come to an agreement with the superintendent of motive power, the question is referred to a joint board, consisting of the general committee, with an equal number of representatives appointed by the management. It is significant that although this type of organization has been in effect about four years, no controversial question has yet been referred to the joint board.

The clerks and maintenance-of-way employees have similar associations. The change in attitude of the shop crafts employees toward the management since July, 1922, is little less than remarkable. Grievances are quickly adjusted. Constructive suggestions are being made by the men and they are uniting with the management in trying to improve the condition and the prosperity of the road.



Layout of the shop tracks and buildings of the locomotive department of the Lehigh Valley shops, Sayre, Pa.

Shop crafts activities at the Sayre system shops

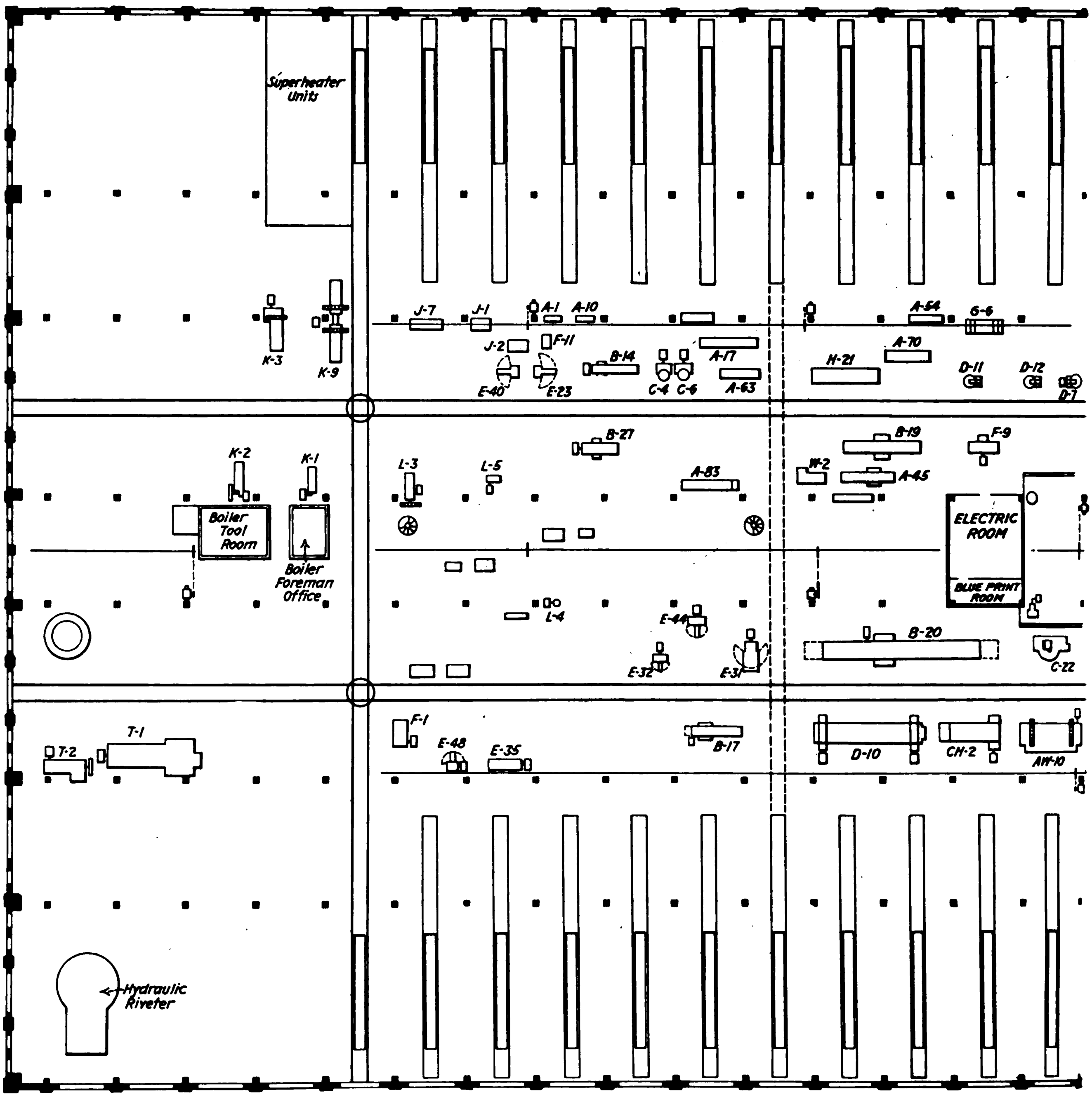
Closely associated with the organization of the maintenance-of-equipment employees at the principal shops at Sayre, Pa., is the Shop Crafts Athletic Association and also the Ladies' Auxiliary of these combined associations.

Located in practically the center of the shop plant is a meeting place for the employees' organizations, known as Assembly Hall. The shop crafts organization wanted to have a meeting place; it seemed desirable to have it on company property convenient to the various departments. The old cab and tank shop, which had been used for emergency purposes during the strike and is centrally located, was available, but it was hardly adapted for a social center or meeting hall. President Loomis indicated that this building would be placed at the disposal of the employees and that material would be furnished for remodeling it and putting it into good shape, if the men would do the work on their own time.

The men went at the task with enthusiasm and energy and were supported by the Ladies' Auxiliary, which had a large part in arranging for the decorations and the finishing touches and giving the whole building a home-like appearance. It is 173 ft. long and 75 ft. wide and is divided into two parts, one a combination auditorium and dancing hall and the other a cafeteria and game room in which pool tables and three bowling alleys have been installed. A maple floor was built over the old concrete floor. The roof girders are concealed by tastefully arranged bunting. A stage with the necessary dressing rooms, has been placed at one end of the hall, the employees purchasing the scenery and properties. The walls were decorated and the windows have been tastefully draped with curtains.

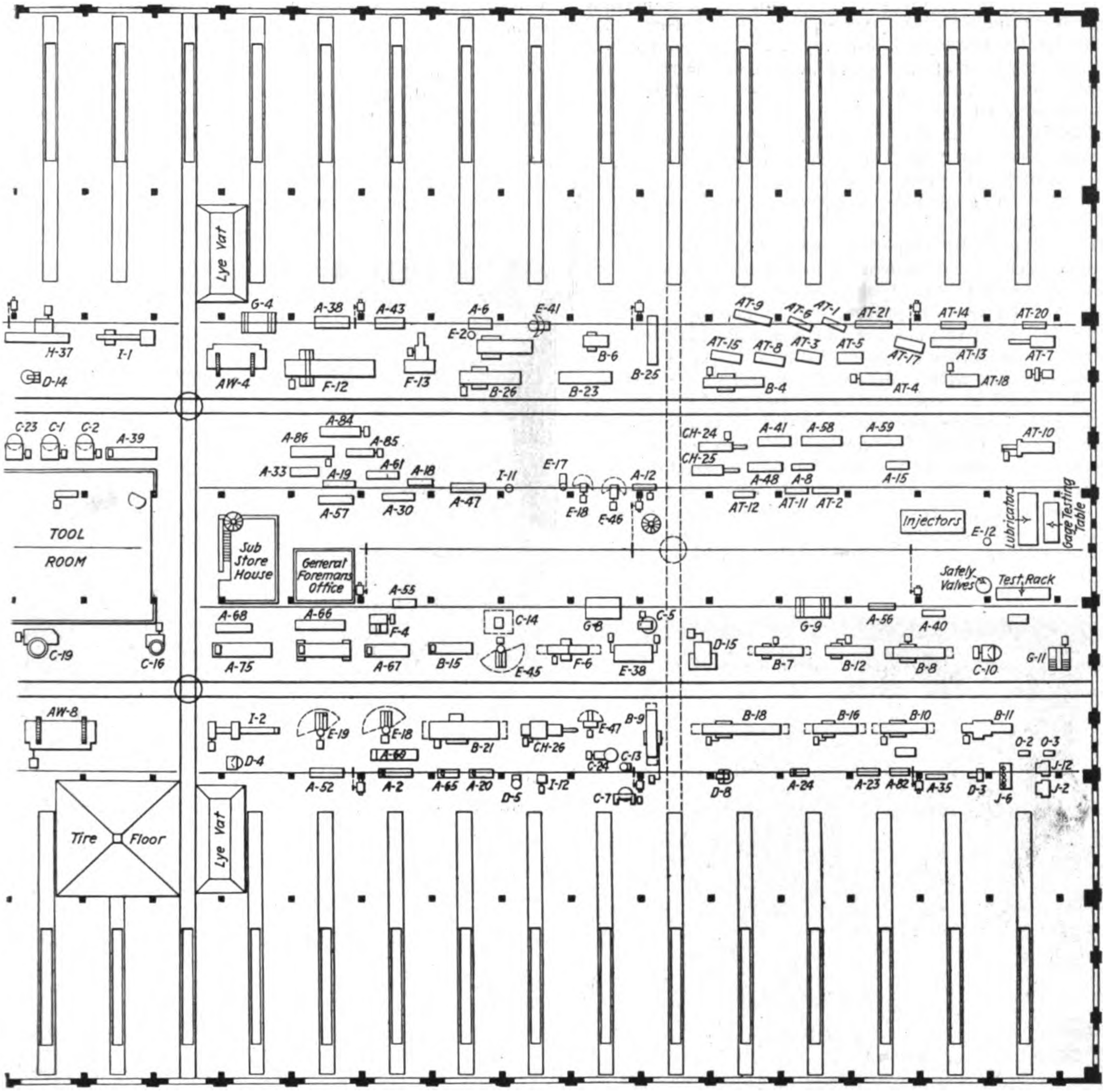
To some extent this hall is the social center of the city of Sayre, which has a population of slightly over 8,000. Dances are held every week and vaudeville shows and other entertainments are put on by the employees and their families at more or less regular intervals. A considerable amount of high grade local talent is available. An orchestra and a band composed of shop employees furnish music and are so well organized and proficient that they occasionally schedule programs of their own. Athletic events, at least to the extent of wrestling and boxing, are also put on occasionally. A charity ball, held under the auspices of the Maintenance of Equipment Association, netted $1,200 clear for the Robert Packer Hospital at Sayre. A Christmas entertainment was furnished for the children of the community and the association also took care of a number of needy families.

At various places on the walls of the auditorium are photographs of the officers of the association and of the Ladies' Auxiliary, of the band and the orchestra. But there is one set of photographs which is highly prized. It includes individual photographs of the officers of the road and some of the board of directors. These photographs mean something. The directors, on their annual inspection trip, spent an evening at Sayre and were en-



Floor plan showing the location of machine tools

Tool Ref. No.	Machine Tool
T-2	7-ft. 8-in. bending rolls
T-1	4-ft. 6-in. bending rolls
K-2	24-in. punch
K-1	42-in. punch
K-3	72-in. punch
K-9	1½-in. combination punch and shear
L-3	72-in. roller shears
L-5	¾-in. tin shears
L-4	Roller shears
B-27	32-in. planer
B-17	48-in. planer
B-14	48-in. planer
C-4	42-in. vertical boring mill
C-6	42-in. vertical boring mill
E-48	72-in. radial drill
E-35	4-in. vertical drill
E-32	72-in. Universal drill
E-31	72-in. radial drill
E-44	72-in. radial drill
E-40	60-in. radial drill
E-23	60-in. radial drill
F-11	10-in. milling machine
J-7	4-spindle staybolt machine
J-1	2-in. bolt cutter
J-2	2½-in. bolt cutter
A-1	14-in. lathe
A-10	16-in. lathe
A-17	30-in lathe
A-63	30-in. lathe
A-83	30-in. lathe
H-21	20-in. piston grinder
W-2	36-in. saw
A-54	24-in. lathe
A-70	42-in. lathe
B-19	60-in. planer
A-45	24-in lathe
B-20	72-in. planer
D-10	24-in. duplex slotter
G-6	18-in. shaper
D-11	24-in. slotter
D-12	18-in. slotter
D-7	18-in. slotter
F-9	No. 4 milling machine
C-22	96-in. vertical boring mill
CH-2	90-in. quartering machine
AW-10	90-in. wheel lathe
AW-8	100-in. wheel lathe
H-37	Guide grinder
I-1	400-ton wheel press
D-14	14-in. slotter
C-23	42-in. vertical boring mill
C-1	42-in. vertical boring mill
C-2	42-in. vertical boring mill
A-39	Lathe
C-19	84-in. vertical boring mill
C-16	72-in. vertical boring mill
G-4	16-in. shaper
AW-4	90-in. wheel lathe
A-38	22-in. lathe
A-43	24-in. lathe
F-12	58-in. by 16-in. horizontal milling machine
F-13	58-in. vertical miller
A-6	16-in. lathe
E-2	12-in. vertical upright drill
B-5	36-in. planer
R-5	36-in. planer
B-26	36-in. planer
B-6	36-in. planer
B-23	56-in planer
B-25	36-in. planer
E-41	72-in. radial drill
A-84	19-in. lathe
A-85	20-in. by 12-ft. engine lathe
A-86	20-in. by 12-ft. engine lathe
A-33	20-in. lathe
A-19	19-in. lathe
A-61	30-in. lathe
A-18	18-in. lathe
A-47	24-in. lathe
A-30	20-in. lathe
A-57	24-in. lathe
A-68	36-in. lathe
A-66	36-in. lathe
A-75	36-in. lathe



and shop equipment in the locomotive shop

Tool Ref. No.	Machine Tool
A-67	36-in. lathe
A-55	24-in. lathe
F-4	48-in. milling machine
B-15	48-in. planer
I-11	50-ton hydraulic flange clamp
E-17	48-in. Universal drill
E-18	72-in. radial drill
E-46	72-in. radial drill
A-12	18-in. lathe
C-14	52-in. vertical boring mill
E-45	72-in. radial drill
G-8	18-in. shaper
C-5	51-in. vertical boring mill
F-6	48-in. milling machine
E-38	2 spindle vertical upright drill
I-2	500-ton wheel press
D-4	14-in. slotter
E-19	72-in. radial drill
A-52	24-in. lathe
E-18	72-in. radial drill
A-60	30-in. lathe
A-2	Special lathe
B-21	72-in. planer
A-65	34-in. lathe
A-20	18-in. lathe
D-5	14-in. slotter
CH-26	Cylinder boring mill
I-12	100-ton hydraulic press

Tool Ref. No.	Machine Tool
E-47	72-in. radial drill
B-9	36-in. planer
C-7	42-in. vertical boring mill
C-24	vertical boring mill
C-13	52-in. vertical boring mill
AT-9	4¼-in. automatic turret lathe
AT-6	2-in. automatic turret lathe
AT-1	1-in. automatic turret lathe
AT-21	1½-in. turret lathe
AT-14	2-in. automatic turret lathe
AT-20	1½-in. turret lathe
AT-15	4¾-in. turret lathe
AT-8	4¾-in. automatic turret lathe
AT-3	2-in. automatic turret lathe
AT-5	3-in. automatic turret lathe
AT-13	2-in. automatic turret lathe
AT-7	4¾-in. automatic turret lathe
B-4	36-in. planer
AT-4	2-in. automatic turret lathe
AT-18	6-in. turret lathe
CH-24	24-in. horizontal boring mill
CH-25	24-in. horizontal boring mill
A-41	24-in. lathe
A-58	24-in. lathe
A-59	30-in. lathe
A-48	24-in. lathe
A-8	16-in. lathe
A-15	18-in. lathe

Tool Ref. No.	Machine Tool
AT-10	6-in. automatic turret lathe
AT-12	16-in. automatic turret lathe
AT-11	16-in. automatic turret lathe
AT-2	16-in. automatic turret lathe
E-12	36-in. vertical upright drill
D-15	18-in. slotter
B-7	36-in. planer
G-9	18-in. shaper
A-56	26-in. lathe
A-40	24-in. lathe
B-12	45-in. planer
B-8	36-in. planer
C-10	52-in. vertical boring mill
G-11	36-in. shaper
B-18	60-in. planer
B-16	48-in. planer
B-10	36-in. planer
B-11	36-in. planer
O-2	8-in. staybolt centering machine
O-3	2-in. centering machine
J-12	3 spindle staybolt machine
J-2	2½-in. bolt cutter
J-6	4 spindle staybolt machine
D-3	14-in. slotter
A-35	20-in. lathe
A-82	8-in. lathe
A-23	18-in. lathe
A-24	20-in. lathe
D-8	18-in. slotter

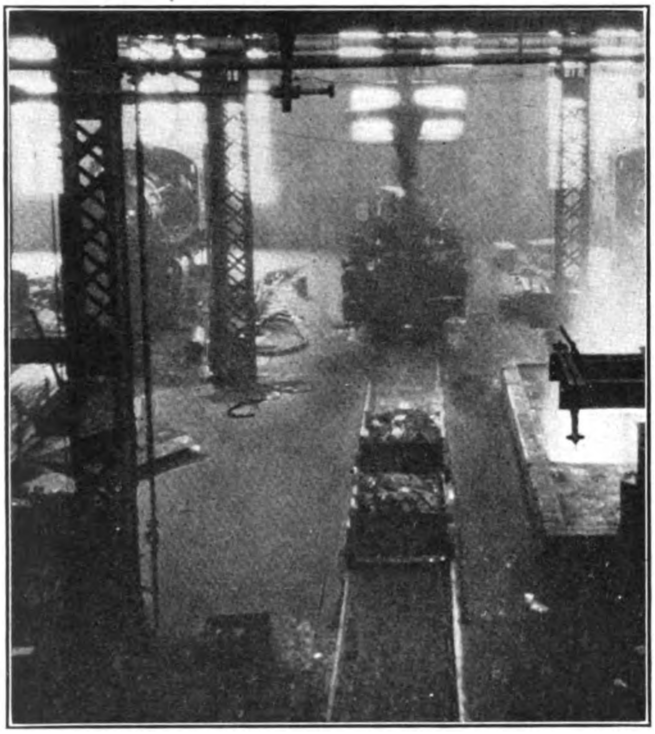
tertained by the Athletic Association. It is said that there were almost 1,800 people present. The thing that impressed the employees, however, was that the directors did not disappear after the vaudeville entertainment, but stayed for the dance, and had a splendid time getting acquainted with the employees.

The Ladies' Auxiliary has 1,132 members and not only has been intensely interested in helping to improve the Assembly Hall and develop a fine social spirit, but has been influential in boosting the railroad and soliciting business for it.

The shop crafts employees do not pay dues to the Maintenance of Equipment Association, but do pay 25 cents a month to the Athletic Association. The dues, supplemented by the proceeds from special entertainments, are used to maintain the Assembly Hall and for charitable and other purposes.

The band, as well as the orchestra and shop quartette, are very much in demand in Sayre and nearby communities. Last summer the band offered to put on a program free of charge for any of the churches in Sayre which might desire to use this form of entertainment in raising funds. All of the churches took advantage of the offer, and, as a result, there has developed a splendid spirit of understanding and co-operation between the shop employees and the community as a whole.

The social activities of the shop crafts at Sayre are



The lye vats are located adjacent to the incoming track, from which the locomotive parts are routed to the different departments

being duplicated to some extent at Easton, Leighton, Coxton, and Ashmore, Pa., Buffalo, and Auburn, N. Y., and other points. The management is glad to co-operate to the fullest extent wherever the men show a sufficient interest to promote such activities.

The cafeteria

A few of the shop employees at Sayre can go home for lunch at noon. Most of them, however, formerly carried lunches. Some of them wanted a hot meal and so a cafeteria has been established in the Assembly Hall by the Athletic Association on a co-operative basis to furnish meals at or near cost. The Ladies' Auxiliary was given general supervision and Mrs. Thomas Holland, its chairman, was asked to take direct charge. A manager was then hired and the cafeteria is now serving about 250 meals each noon. Any of the men are welcome to bring their lunch boxes into the dining hall and, if they so desire, can purchase hot coffee or supplement their lunch in other ways.

Another interesting development has been 10-minute educational and inspirational talks in the dining hall dur-

Efficient crane service in the machine shop, especially for wheel repairs, is an important factor in the production work at Sayre

ing the lunch hour. Various officers and others are invited to give these talks, most of them relating to the railroad and its operation or to matters of special interest to the employees.

Foreman training

The study made by the *Railway Mechanical Engineer* in 1925 showed that the Lehigh Valley had approached the problem of foreman training somewhat differently from other roads and that the mechanical department at Sayre was going at the task in a methodical and most effective manner. A brief description of the foreman training work at Sayre was published in the June, 1926, issue of the *Railway Mechanical Engineer,* page 336. The foremen meet in the apprentice school room, which is located in a building between the storehouse and main office building and the blacksmith shop. The class is in charge of the apprentice instructor, which includes 51 foremen, gang leaders, etc.

A better understanding on the part of the foremen of the way in which to lead their men and of their relations with their fellows and to the management, naturally is a great help in developing and maintaining the right sort of contacts between the men and the higher officers. It keeps open the channels which make it possible for the management to be more responsive to the needs of the men; it also keeps the men better posted as to the problems of management and the condition of the property.

Dealing with the public

The relations of a railroad to the public and its relations to its employees are closely interwoven. The employees in some cases, such as Sayre, form a considerable part of communities which are served by the railroad. In educating the community as to the facts about the

railroad it will at the same time reach the employees. On the other hand, the employees, if they are keenly interested in the railroad's welfare, can be an important factor in "selling" the railroad to the community. It is interesting to note how the employees, of their own volition, are taking a hand in the matter. Reference has already been made to the fact that the Ladies' Auxiliary of the shop crafts organization at Sayre has been active in boosting the road and soliciting business for it. A fair example of this is a pamphlet entitled, "Steady Employment on the Lehigh Valley," which was distributed by the Maintenance of Equipment Association and Athletic Association at the Sayre shops. It reads as follows:

To Fellow Employees:

The first step in our campaign to keep L.V.R.R. employees steadily at work was a letter to all shippers and receivers of goods in this vicinity, urging them to use L.V.R.R. lines as much as possible in all their movements of freight.

The next step is squarely up to every man employed by the L.V.R.R. for "The Lord helps those that help themselves." You can be of great assistance in keeping yourself and fellow employees at work if you will earnestly strive to carry out the following suggestions:

1—Be loyal to the Lehigh Valley, not only in your work, but by telling of its unexcelled service and advantages to all travelers and shippers whom you meet.

2—Buy your coal, food and merchandise from those who ship and receive freight over the Lehigh Valley.

3—Urge your friends to patronize the merchants and business men who ship via Lehigh Valley.

4—Tell your merchants that over one-half of the freight charges they pay are paid out in wages and so benefit them.

5—Be saving in your work and time. Efficient labor and careful use of material means more money for the company to spend on the great amount of work always waiting to be done.

Your co-operation in carrying out these suggestions will insure steady employment and prosperous conditions for all.

The result of these activities on the part of the management and the employees has borne much fruit in developing a more cordial spirit between the public and the Lehigh Valley, and it has had a splendid reaction upon the relations of the employees with the management.

Both locomotive and wooden car repairs are handled at Sayre

The locomotive shops at Sayre perform practically all of the classified repairs on the 941 locomotives owned and operated by the Lehigh Valley. In addition, the car shop, which is located to the left of the power house, handles all the heavy repair work on freight and milk cars, refrigerator cars and cabooses, owned by the company. Both the car and locomotive shops are under the jurisdiction of the shop superintendent and the same plan of personnel organization is applied to both departments.

The locomotive shop building has a total of 52 pits and houses the machine shop, erecting shop, boiler and cab departments. It is 336 ft. wide by 740 ft. long. The pits are arranged transversely, 26 pits on each side with the various machine departments located along the center of the building. All departments are provided with adequate overhead traveling crane service, the two erecting shops being served with two 220-ton cranes for handling locomotives from the incoming track to the pit. In addition, 11 overhead traveling cranes are provided for handling material in the various departments located in the locomotive shop building.

Location of departments facilitates the work

Referring to the drawing showing the location of the shop tracks and buildings, locomotives to be repaired are taken into the shop via the turntable located to the northeast side of the building. A view of the turntable and tracks leading to it is shown in one of the illustrations. The track leading from the turntable into the locomotive shop extends past the lye vats, which are located on both sides of the building, as shown in the floor plan drawing. Incoming locomotives are moved by overhead traveling cranes from the incoming track to the pit to which they are assigned.

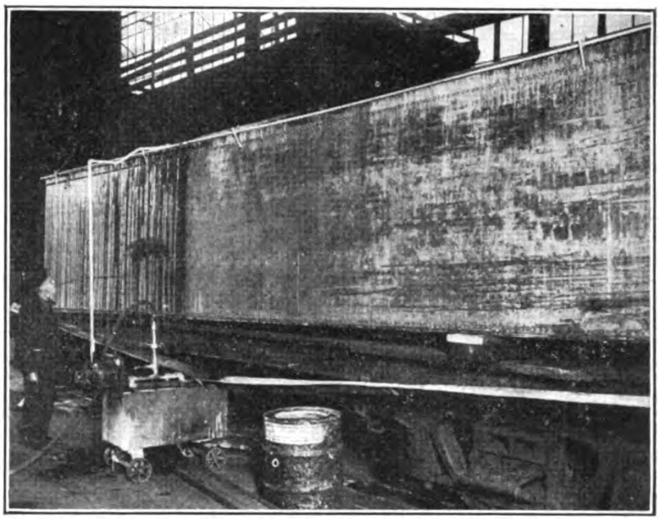
Five helpers and laborers, under the supervision of a mechanic, do all the stripping for 24 pits. This work includes stripping the locomotive, placing the parts to be cleaned in the lye vat and delivering them to the various departments in the machine shop. In stripping the locomotives, the rods are taken down first, pedestal binders removed, the locomotive raised and the wheels moved forward into the short bay between the erecting and machine bays. All locomotive parts are moved to the front, placed in a basket and taken to the lye vat.

Special effort is made to see that the cranes are not used any longer than necessary for this work. If the motion work, for example, has not been entirely taken down, the crane is released and a trip to the lye vat with these parts is made later. The location of the erecting shops on both sides of the locomotive shop building and the machine shop departments between the two greatly facilitate the work of routing and handling material. Locomotive parts are routed from the lye vat directly to the proper departments where they are inspected by the foreman or his representative.

(The concluding installment of this article will appear in the December issue. It will include a description of the scheduling system used in handling locomotive repairs and also descriptions of many of the detail operations and some of the shop kinks and fixtures that have been developed by the employees.—Editor.)

Stripping paint from locomotive tenders

ONE of the most recent methods of stripping paint from locomotive tenders is shown in the accompanying illustrations. A small portable tank, heated by steam, is connected to a long pipe which is clamped to the

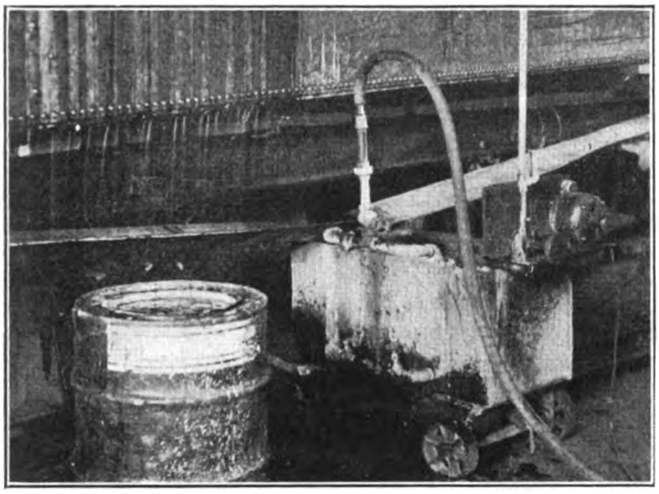


Equipment in place for stripping the paint from a locomotive tender

side of the tender and in which there are a series of ⅛-in. holes. A small motor is attached to the portable tank to provide sufficient pressure to pump the paint removing solution up into the pipe on the tender. The pressure need only be sufficient to make the solution pour out onto

the side of the painted surface. A trough is located under the lower edge of the tender side to catch the cleaning solution and convey it back to the solution tank. In this manner the solution is reclaimed and can be repeatedly reused.

An interesting part of this work is the question of cost. It has been the practice on most railroads to remove the paint from tenders about every six or seven years. Experienced railroad men feel that the painted surfaces should be stripped every three years and painted yearly. The reason why some such schedule has not been put into effect is because of the excessive costs. By using



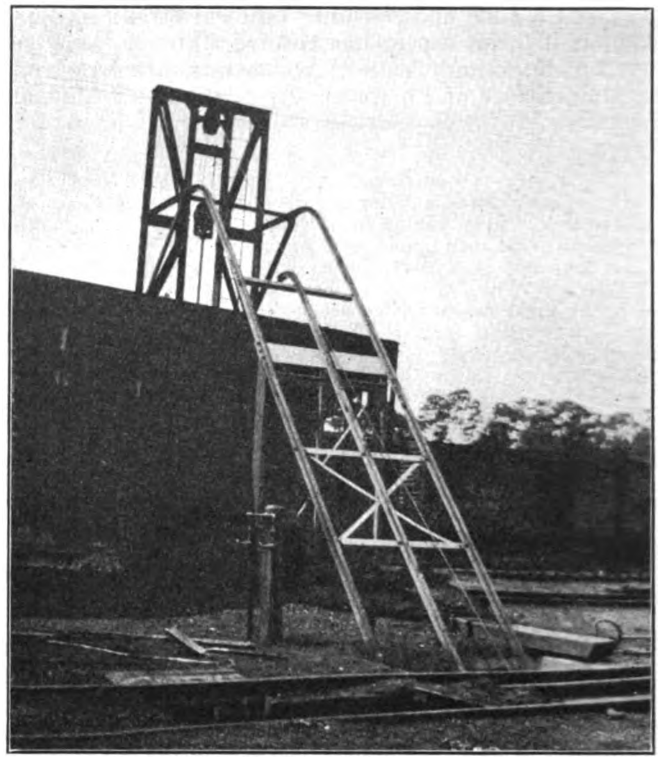
A closer view of the tank, the motor and troughs by means of which the solution is reclaimed

varnish remover it requires about $25 of labor and material to strip an 8,000-gal. tender, including the coping. With paint removing solutions and the method used as shown in the illustrations, an 8,000-gal. tender was stripped in 11½ hr. using about 150 lb. of materials. This particular job was particularly difficult. With properly designed equipment and an ordinarily difficult piece of work to do, the time could be cut to about eight hours and the consumption of materials to approximately 50 lb.

Loading cinders from locomotive ashpits

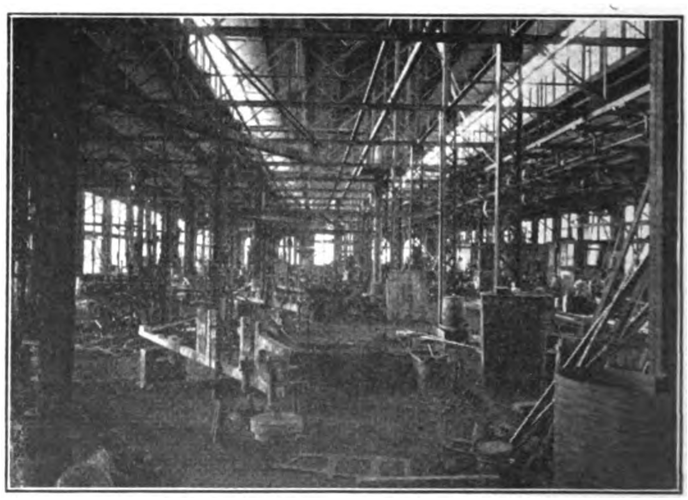
The device shown in the accompanying illustration facilitates the removal of cinders from small locomotive ashpits. A pit is dug beneath the track and lined with concrete walls. This excavation extends a few feet out beside the track. A small dump car built in a diagonal position the elevated end of which terminates over the loading track passes through the opening alongside of the ashpit.

The dump car is made up of two small trucks with flanged wheels that run on the diagonal track which is made of discarded rails. The rectangular body of the car, made of sheet metal, holds the discharge of four or five locomotives. One half of the bottom or floor of the car body is loose and hinged at the lower corner with heavy strap hinges. Near the center of the car bottom and attached to the drop lid or shutter is another wheel that runs on a center rail between the two forming the main part of the track. This center rail extends to a few inches past the edge of the gondola cars into which the cinders are loaded, where it curves downward. The car is lowered into the pit until several engines have been cleaned, the cinders dropping down into it between the rails. A gasoline engine drives a drum on which a cable winds on the opposite side of the gondola being loaded, by which the cinder car is drawn up the diagonal track until the wheel under the center comes to the downward curve in the center rail, where it rolls



A simple device for loading cinders from an ashpit where an overhead crane is not available

over the curve and drops down, allowing the hinged half of the car bottom to drop, releasing the load into the gondola. The hinged half of the bottom is the half next to the cinder pit track, and because of the slanting position of the other half of the bottom, the cinders slide out without attention.



Interior view of the blacksmith shop of the American Locomotive Company, Schenectady, N. Y.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

A question of three-cylinder valve motion patents

New York, N. Y.

To the editor:

Referring to the article by Jack Britton in the August issue of the Railway Mechanical Engineer, entitled "Setting valves of three-cylinder locomotives," Mr. Britton gives credit to H. N. Gresley for the invention of a system of levers whereby the valve for the inside cylinder of a three-cylinder locomotive derives its motion from the movements of the valves of the two outside cylinders.

Mr. Britton is not the first to overlook the fact that this system of valve gear is the invention of the writer, to whom United States patent No. 946,083 was issued on January 11, 1910, covering broadly the operation of a central valve of a three-cylinder locomotive by the combined movements of the two outer valves.

About five years later, Mr. Gresley applied this principle to some three-cylinder locomotives built by him for the London & North Eastern Railway and on November 8, 1915, English Patent No. 15,769 was granted him covering his construction.

It should be stated that Mr. Gresley's method of applying the principle is slightly different from mine, his variation being used by the American Locomotive Company. However, the underlying principle is the same and the method which he uses is broadly covered by my patent.

H. S. Vincent.

Tests of cast iron brake shoes—An opinion

San Francisco, Cal.

To the editor:—

Referring to my letter to the editor which was published in the August issue and Mr. Williams' reply, on the subject of comparative tests of cast iron brake shoes, I am still of the opinion that in any tests made of brake shoes, the wear of the wheel or tire should be taken into consideration. I have no doubt that with different kinds of metal in the brake shoes, different kinds of wear will appear on the tread of the wheel. For example, we recently made up for experimental purposes, some cast steel brake shoes and applied them to the driving wheels of a yard engine, in comparison with our standard brake shoes, with the result that the two tires to which the standard shoes were applied showed a reduction in diameter of .25 in. as against an average on the four wheels to which the cast steel shoes were applied of .41 in. The shoes were applied October 1, 1925, and the measurements above mentioned were taken March 9, 1926.

At the same time measurements were made of the standard shoes, and the cast steel shoes, and these showed that both kinds of shoes had worn at the top an average of 1.06 in., while the standard shoes had worn at the bottom an average of 1 in. and the cast steel shoes an average of 1.15 in.

I am merely quoting the above figures to illustrate my meaning in connection with the advisability of considering tire wear in brake shoe tests.

Dennistown Wood,
Engineer of tests, Southern Pacific.

The answer

During the past five years, inquiries made of the leading American railroads for some specific data or records showing the comparative wear of wheels with different types of brake shoes in use, indicate that the wheel wear produced by any of the various types of cast iron brake shoes is so small compared with the wear produced by the action of the rail that it is impossible to measure it.

The brake shoe testing machine at the Mahwah, N. J., plant of the American Brake Shoe Company, bears out the above in laboratory tests where small losses can be measured. This machine is similar to the testing machine at Purdue University and at the testing laboratory of the Pennsylvania at Altoona, Pa. On these machines either a steel tired or chilled cast iron wheel may be mounted on an axle and does not come in contact with the rail. After thousands of stopping tests with all kinds of brake shoes of cast iron (Diamond-S, special chilled, etc.), through a wide range of speeds from 10 to 80 m.p.h. and wide ranges of brake shoe pressures and wheel loads, the testing engineers have never been able to measure the reduction in the wheel circumference on either a steel tired or a chilled iron wheel.

The brake shoe testing machine at Mahwah, N. J., has been in almost constant use for the past 15 years in development work for the American Brake Shoe and Foundry Company, and by numerous railroads as well who have had their mechanical engineers make tests of various types of brake shoes. Wheels have been removed for one reason only during that time; viz. fatigue from repeated heating and cooling, resulting in cracked treads. When measured, these wheels have not shown any reduction in circumference.

It is practically impossible for a brake shoe to cause any wear on a chilled iron wheel on acount of the fact that the circumference of a 33-in. wheel is about 104 in., while the length of a brake shoe is only 13¾ in. Of this 13¾ in. only about 2½ in. at each end is chilled or white iron and the remainder is gray iron, while the entire circumference of a chilled iron wheel is white iron. The brake shoe becomes much hotter than the wheel because it is absorbing heat throughout its entire length during the time the brake is applied while one-seventh to one eighth of the wheel circumference is absorbing and the remainder is radiating heat. The face of the brake shoe accumulates heat almost instantly and small particles are torn off, while the wheel tread re-

mains cool and hard. During a long brake application, the brake shoes may become red hot, but the wheel heats up slowly. Chilled iron, when cold, is hard enough to turn the point of a prick punch, but when heated to 800 deg. or more, becomes soft and will not turn the point of a prick punch.

One railroad made the following test on the wear of the rolled steel wheel by the special chilled and the expanded metal insert shoes on passenger coaches with the following results:—

Special chilled type	.2166 in.
Expanded metal insert	.1551 in.

Arrangements were made to keep the best record possible of the wheel wear by measuring the circumference of the tires when the brake shoes were both applied and removed. The average losses in circumference per wheel with the two types of brake shoes were as above.

These measurements would seem to indicate that the expanded metal insert caused less wheel wear than the special chilled type, but the fact of the matter is that the reduction in circumference is so small that the error in measurement with a steel tape would account for the difference. It is safe to say that the reduction in wheel circumference was actually the same under both shoes, as a difference of .06 in. is too small a quantity to determine with a steel tape on a wheel of 104 in. or more in circumference.

From the above results, it is practically certain that the entire reduction is due to the rolling of the steel wheel on the rails. This can readily be checked by examining a wheel in service and noting the location of the wear. It will be seen that the brake shoe plays very little part in the wear of the wheel.

FRED H. WILLIAMS,
Assistant test engineer, Canadian National.

Car wheel grinding advocated

ST. PAUL, Minn.

TO THE EDITOR:

The editorial, "Car Wheel grinding advocated," published in the June 16, 1926, issue of the *Railway Age Daily Edition,* recalls some observations I made when, as chairman of the committee, I was preparing the paper on slid flat wheels which was presented before the 1895 convention of the Air Brake Association. At that time I noted how eccentric wheels apparently contributed to wheel sliding. This was further confirmed later by special checks of slid flat wheels on three different railways where they did not grind their old wheels. On one road the check disclosed that an old wheel boring machine was turning out as eccentric wheels most of its product, which resulted in the machine being scrapped. Following is an abstract of the germain paragraphs of that report which may be helpful to your readers:

"Then, too, where wheels are out of round or not centrally bored, there must generally be a tendency at each revolution to force the brake beam farther from the center of the axle, which would be equivalent to an increased shoe pressure. Some railway companies grind all cast-iron wheels after they are mounted and at least one manufacturer rough bores and grinds one make of wheel before sending it to the user.

"Reports from a few roads using wheels which have undergone one or the other method indicates the undoubted advantage in preventing wheel sliding. It has been noted by a member of this committee that in the shops of a road which makes a practice of grinding flat wheels which are not too bad, such wheels are frequently out of round and flat spots are located on the part of the tread that would be in contact with the rail when the greatest diameter of the wheel was about under the brake shoe.

"It is reasonable to assume that this trouble would exist the least where grinding new wheels is practiced because of indicating all such defects and tending to their prevention in casting and boring."

F. B. FARMER,
Northwestern representative, Westinghouse Air Brake Company.

Another method of making spring bands

WAYCROSS, Ga.

TO THE EDITOR:

In glancing through the March issue of the *Railway Mechanical Engineer,* page 176, I noticed some views and sketches of solid spring bushings and bands. I have been engaged in this class of work for years, during the course of which I have worked out a method of manufacture which I believe is much quicker and easier than the method described in your March issue.

On the Atlantic Coast Line we do just the opposite from what is described in the article referred to, which primarily consists of stretching by punches. We draw the material in a mandrel over a bridge tool. In determining the amount of material for a band we figure the weight of the outside diameter of the band, weight of inside diameter, subtract one from the other, and add to the remainder the weight of the material which is punched from the hole. Suppose we are to forge a band with a 14-in. outside diameter, a 10-in. inside diameter and an 11-in. face. The calculations are made in the following manner:

14-in. round steel weighs 43.62 × 11 =	479.82 lb.
10-in. round steel weighs 22.65 × 11 =	244.75 lb.
Actual weight of band	235.07 lb.
4-in. round steel weighs 3.57 × 11 =	39.27 lb.
Weight of band plus weight of steel removed from 4-in. hole	274.32 lb.

Thus, to obtain the proper size billet to make the band with the above dimensions, we figure as follows:

9-in. round steel weighs 18.02 × 15¼ = 274.80 lb.

The proper size billet is cut off to length from a 9-in. axle, knocked down on a hammer to within 1 in. of the proper thickness after which the holes are punched. It is then ready to go on the bridge tool to be stretched.

Two mandrels are used, one 3½ in. round and the other of whatever size radius the band happens to measure. The band is first stretched almost to size in the small mandrel after which it is put on the second mandrel. All this is done in one heat which is much faster, requires less work and less tools, and gives greater quantity and better quality. It also eliminates all the unnecessary work of lifting up and down.

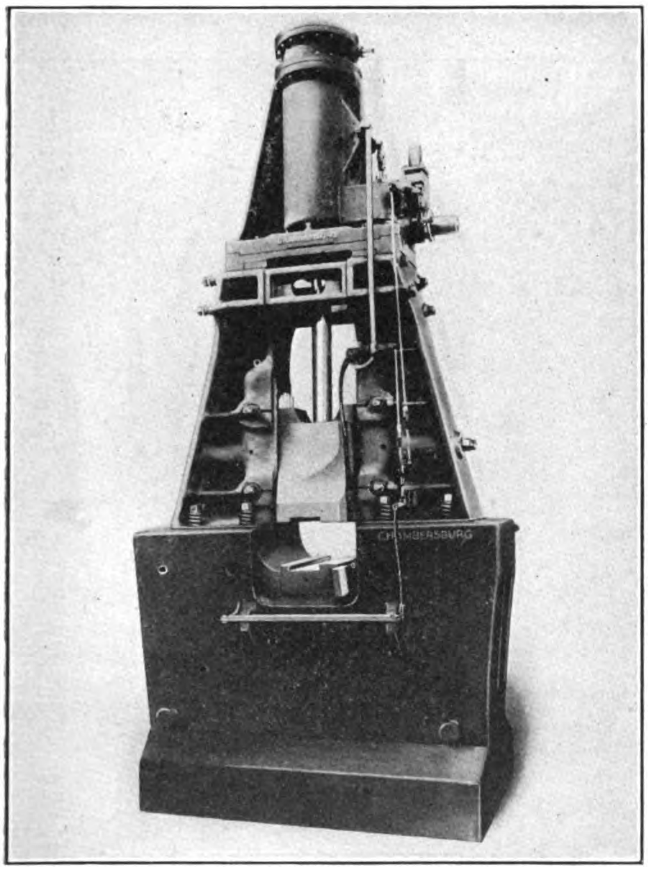
By this method the bands can be made according to calculations, thus eliminating all guess work. If the weight is figured correctly and care is taken in cutting off the billet, the band will be the right size and also have a square edge.

The other method will work all right for narrow bands, but how about a band with a 10-in. face? Most of our bands average from 7 in. to 12 in. wide, 14¾ in. outside diameter and 12 in. inside diameter, which would be almost impossible to manufacture by the other method.

W. W. SHARKFORD, JR.

Chambersburg type B steam drop hammer

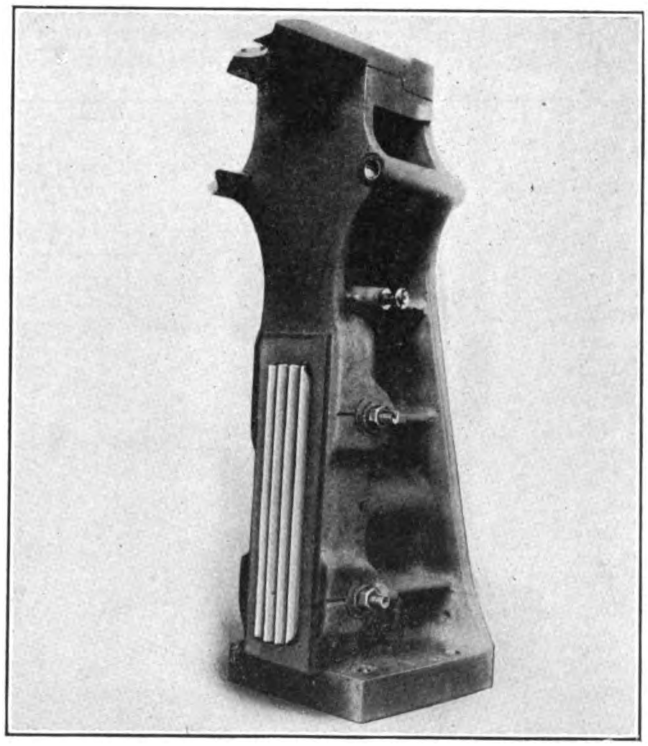
THE Chambersburg Type B steam drop hammer, the 12,000 lb. size of which is illustrated, has recently been placed on the market by the Chambersburg Engineering Company, Chambersburg, Pa. The hammer embodies several improvements to insure the permanency of alinement and decreased operating and maintenance costs.



The 12,000-lb. Chambersburg Type B steam drop hammer

The anvil has been redesigned so that all sharp corners are eliminated, and large fillets are provided throughout the frame seats. The wearing wedge is installed to take up wear between the frames and the anvil. The seats of the frames have been raised to a point approximating the dividing line of the dies, so as to decrease materially the tendency of the frames to rock. The frame to anvil bolts have been provided with keyed heads in the anvil, which are located above the floor line and are, therefore, readily accessible. Cores below the sow block have been eliminated, and the wedges and bolts nearest the sow are inserted in holes bored from the solid metal.

The bearing surfaces on the bottoms of all the frames have been increased by extending the frames from left to right. Where single tie bars are standard, the tie bar has been dropped below the top of the frame, to secure greater strength and effectiveness. The frames are tongued to the interlocking tie plate at the top.



Detail assembly of the frame and the tie plate

The cylinder follows the standard Chambersburg self-draining design and, in addition, is provided with a removable liner which provides for renewals.

The interlocking tie plate has been designed to elim-

inate any overhanging, thereby reducing the hazard of breakage. This tie plate is dove-tailed in both directions to the frames, fixing them in alinement, and is counterbored in its center to receive an extension from the throat of the cylinder, providing for the maintenance of the cylinder alinement. The ends of the tie plate are also lipped to the base of the cylinder which was described in the preceeding paragraph.

The guides have been redesigned to be invertible, as well as interchangeable, and guide adjusting bolts have been provided with ratchets to lock them in position. The cam mechanism has been redesigned to eliminate all square ends and keys. The cam and its arm are forged from the solid. The valve rocker bearing is bronze bushed.

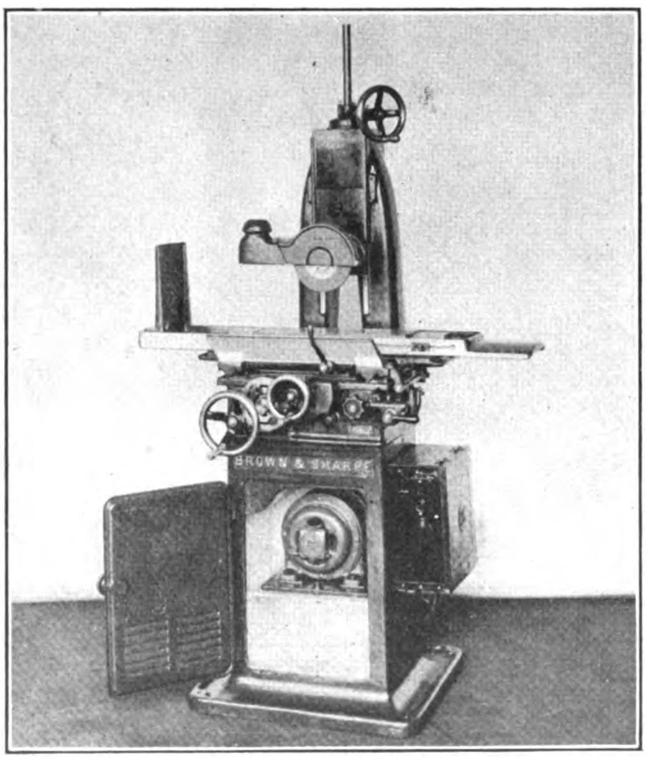
In designing the Type B steam drop hammer, studs have been eliminated, as far as possible, in favor of through bolts, with the result that the only studs used are some of the packing gland studs, and those cylinder cover studs over the steam ports.

Hot forged steel unions

STEEL unions forged hot from solid steel bars and suitable for steam, hot and cold water, gas, oil and air service, are being manufactured by the Central Forging Company, Catawissa, Pa. Since the unions are made of the same material as the pipe to which they are attached, they will have the same expansion and contraction. They can be furnished with seats steel to steel, bronze to steel and monel metal to steel, all of which are locked in place. They are recommended for hydraulic pressures, cold test, up to 6,000 lb. per sq. in., and when fitted with monel metal seats for the highest pressures and temperature at which steam is used.

B. & S. surface grinding machine

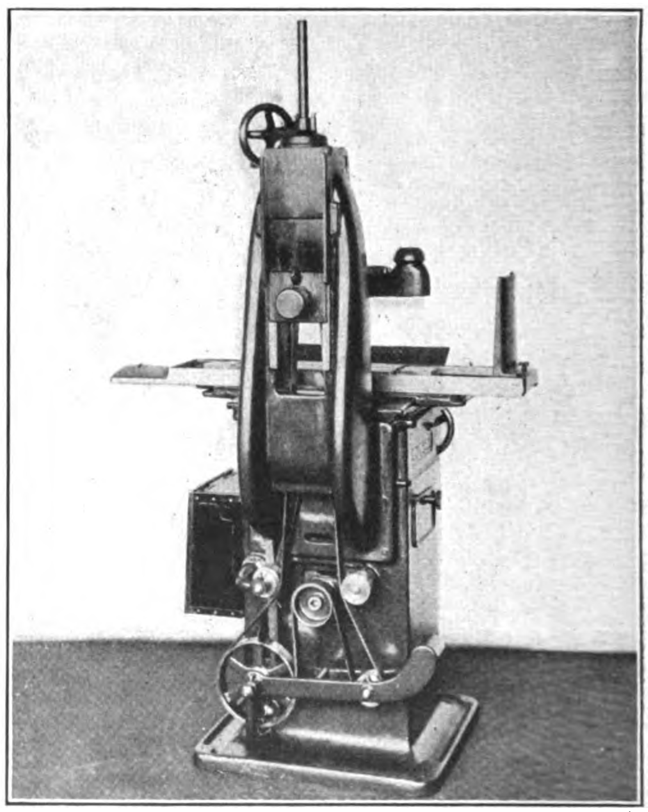
THE latest addition to the line of complete-unit machine tools manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I., is the No. 2 surface grinding machine, which has the motor enclosed within the base of the machine. In this position the motor is completely protected from oil, water, dust, dirt and other sources of trouble to which



The motor is mounted in the base of the machine with ample space beneath for storing machine attachments or tools

motors located on brackets outside of the machines are sometimes subjected.

The motor, which is of the constant speed type, is securely mounted on a plate which is in turn bolted to a shelf in an oil-tight compartment in the machine base. Ventilators cast in the door provide sufficient circulation



A rear view of the Brown & Sharpe No. 2 surface grinder, showing the automatic belt tightener

of air to insure a cool-running motor. Additional space is furnished under the motor shelf for storage of attachments and machine accessories. An option of several makes of motors for either direct or alternating current is given. Power is transmitted by belt. A tightener auto-

matically keeps the belt at the proper tension regardless of the height of the spindle head. The control box is located on the side of the base with the push-button control in a convenient operating position.

The longitudinal travel and the transverse movements of the table are automatic, the latter being provided with an automatic stop which throws out at any desired point. A knurled knob on the front of the machine disengages the power cross feed.

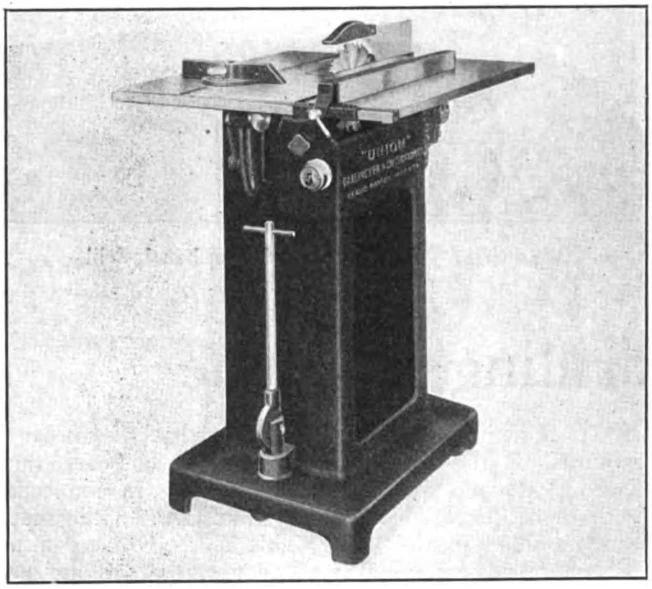
Controls are conveniently centralized and all vital parts are completely covered with guards which serve to protect them from destructive abrasive dust.

The machine accommodates work up to 18 in. long, 6 in. wide and 9½ in. high, when a wheel 7 in. in diameter is used. A floor space of 65-in. by 30-in. is required for the machine which weighs net, without the motor, 1,350 lb.

The attachments furnished as extras for this machine are the exhaust arrangement, which draws the dust away from the machine through the wheel guard and a telescoping pipe and discharges it into a settling pan; the wet grinding attachment, which consists of supply tank, centrifugal pump, work hood and splash guards; a magnetic chuck, and 4¾-in. index centers.

Portable motor-driven universal saw

A PORTABLE floor type universal saw which combines all of the advantages of the portable bench machine with the additional advantage of having a rigid cast iron pedestal in place of the ordinary work bench, has been placed on the market by the Gallmeyer & Livingston Company, Grand Rapids, Mich. This pedestal provides not only a convenient operating position when the saw is in use, but a convenient means of moving it out of the way when not needed. Two rollers at the back and two stationary feet at the front of the base give a firm setting on the floor when in operation. When the handle is pulled forward in a position for moving the machine, a cam automatically raises the feet from the floor and brings the weight of the front of the machine onto a third roller which is carried on a swivel bearing moving with the handle shown in both of the illustrations.



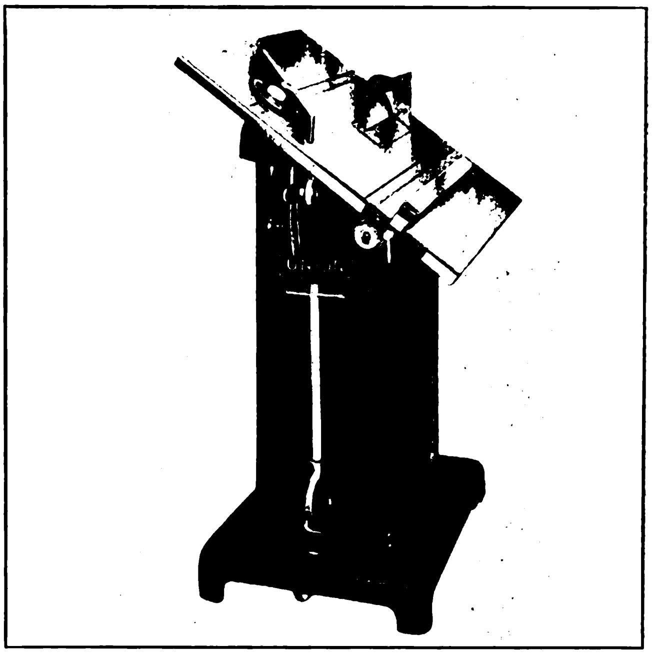
The saw blade can be raised and lowered from flush with the table to 2½ in. above the table

The motor and all working parts are built into the upper portion of the machine so as to afford a thoroughly self-contained outfit. The upper part of the machine can be removed from the pedestal and used as a bench type should occasion demand.

The machine can be supplied with either a ½-hp. repulsion induction type motor to operate from a lamp socket or with a 1-hp. repulsion induction-type motor to operate from the power line. When equipped with a power line motor and 8-in. diameter saw, will handle stock up to 12 in. wide by 2½ in. thick. The repulsion induction type motor is belted to the saw arbor.

The table is a solid, one piece casting, 25 in. by 26 in. fitted with a removable throat plate to allow for the use of dado heads, cope heads, grooving saws, etc. The saw can be raised and lowered from flush with the table to 2½ in. above the table, making it possible to cut 2½-in. stock. The table tilts up to 45 deg. and can be instantly locked at any desired setting as shown in one of the illustrations.

The 8-in. saw is properly guarded at all times and a splitter guard is also a part of the safety equipment. A switch for starting and stopping the machine is conveniently placed on the front of the machine so that there can be no temptation to let the machine run when not needed. The machine can be shut down between pieces, thus saving power.



The table of the Union portable universal saw tilted to a 45-deg. angle

The cross-cut gage can be used on either side of the saw as two planed slots, one on either side of the table are for this purpose. This gage can be quickly set at any angle and clamped rigidly in position for cutting off at any desired angle. Holes are provided for mount-

ing an auxiliary wood face piece when such action is desired.

The ripping gage is machined on both sides and can also be used on either side of the saw. The tightening of the lever head screws locks the ripping gage in position and, automatically lines it up with the saw.

Superior 10-in. bench drill

THE Type M bench drill manufactured by the Superior Machine Tool Company, Kokomo, Ind., has been especially designed for those shops in which light accurate drilling is required. The bottom cone bracket can be reversed to place the belt shifter on either side of the machine so that the driving belt can be either run from overhead or from under the bench or stand.

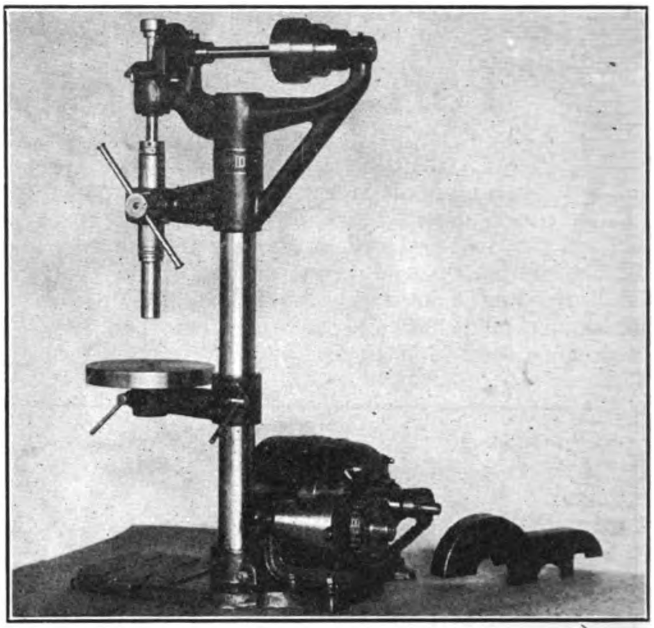
The drive can be furnished with regular tight and loose pulley, or geared motor drive. When furnished with the geared motor drive, the motor and the drill base are cast integral and the motor is mounted at the side of the machine at the rear. This shortens the length of the machine so that it can be placed on an ordinary work bench.

The cone pulleys take a 1¼-in. belt and the tight and loose pulleys a 1½-in. belt.

The feed lever on the right-hand side of the machine is held in any position by a compression spring. This prevents the spindle from dropping when the hand is removed from the feed lever. On the motor-driven machine a silent chain drive is used. All the gearing is covered by guards.

The following are a few of the general specifications:

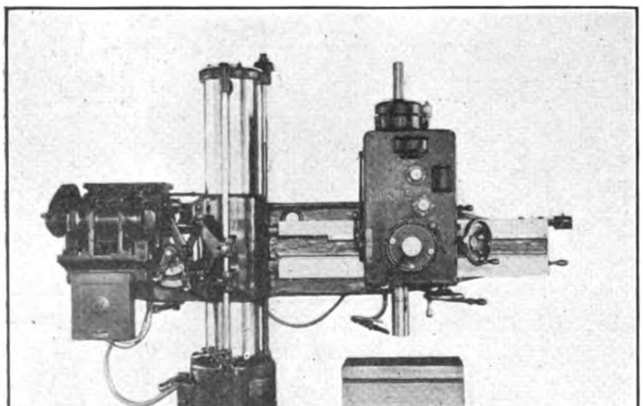
Drills, to center of	10¼ in.
Height, spindle extended	35½ in.
Takes between table and spindle	10⅞ in.
Takes between base and spindle	16 in.
Traverse of spindle	3½ in.
Traverse of table	10⅞ in.
Working surface of base	7 in. by 8 in.
Spindle bored Morse taper	No. 2
Diameter of table	8 in.
Speed of tight and loose pulleys	550 to 800 r.p.m.
Motor	1,800 r.p.m.—¼ hp.
Net weight tight and loose pulley drive	95 lb.



Superior Type M motor driven bench drill

Four-foot radial drilling machine

A FOUR-FOOT radial drilling machine with the motor and ball bearing speed box mounted on the arm has recently been placed on the market by the Morris Machine Tool Company, Court and Harriet streets, Cincinnati, Ohio. The fact that the motor is mounted on the arm eliminates four bevel gears, three speed gears and the shafts and bearings in connection with these gears which were required when the motor was mounted in the base. This method of mounting the motor also eliminates the constantly running arm raising and lowering gears on top of the column. The arm raising and lowering unit is mounted on the back of the arm and is only in operation when the arm is being raised or lowered. Either a d.c. variable speed motor or a constant speed motor and ball bearing speed box can be used.



A 4-ft. radial drilling machine with the motor and ball bearing speed box mounted on the arm

The head is fully enclosed and well balanced on the arm so that it travels freely One lever operates two clamp screws securely clamping the head on the arm without affecting the alinement. Oil is properly distributed throughout the head from an oil reservoir at the top of the head. The feed worm wheel dips in a trough of oil.

The spindle is a hammered steel forging and runs in phosphor bronze bearings in the sleeve and is driven by two keyways. The spindle is fitted with a ball thrust bearing and the spindle gear is mounted on a ball bearing. The feed unit is mounted in the head. On the 4-ft. radial there are eight feeds ranging from 5 to 42 thousandths per revolution of spindle and four thread leads: 8, 11½, 14 and 18 threads per inch.

The tapping attachment and back gear bracket is a

unit mounted on the back of the head. The tapping attachment runs in oil and its frictions are of the multiple disc type. The speed box of the sliding gear type is equipped with ball bearings which are lubricated from the splash of oil in the gear box. The driving pulley is fully enclosed and fitted with a friction clutch operated by a single lever. The drive pulley runs on ball bearings when the clutch is disengaged.

The arm is designed to resist properly torsional and lifting strains. The bearing on the column is extra long and the arm is clamped in any position by a single lever convenient to the operator. The arm is raised or lowered by a power comptroller through a lever at the bottom of the column. This lever accomplishes two purposes. It automatically unclamps the arm before the elevating or lowering gears are engaged by the first movement of the lever. A little further movement of the lever engages the gears and the arm is raised or lowered to its desired position. In bringing the lever back to its central position until the latch catches, the gears are disengaged and the arm clamped by one movement of the lever.

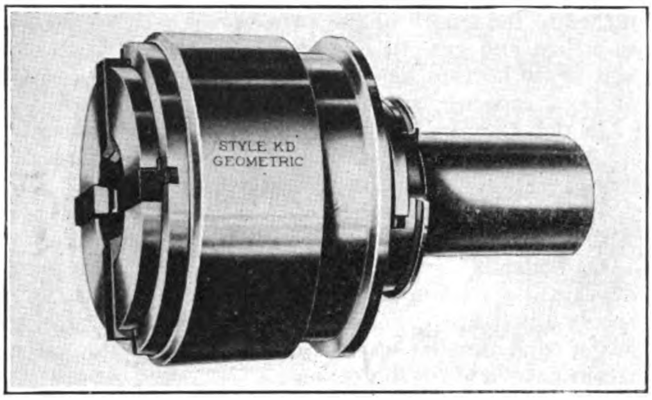
The oil channel around the base drains through a screen into a large reservoir, having an overflow partition which is provided to keep chips and dirt out of the pump.

Rotary opening die head for shoulder threading

A NEW rotary opening die head, which is said to have been developed to meet the demand for a flange trip type of head that will trip at precisely the point for which it is set, has been placed on the market by the Geometric Tool Company, New Haven, Conn.

This tool is designated as the style K-D and is adapted especially for shoulder threading. It is of small diameter, and is designed to swing on Gridley, Acme, Cone, New Britain and similar machines, also on drilling machines, threading machines and practically any live spindle. Five sizes—5/16 in., 9/16 in., 1 in., 1¼ in. and 1½ in.—are regularly available, and other sizes can be obtained to order. The chasers interchange with the company's style K heads of corresponding size.

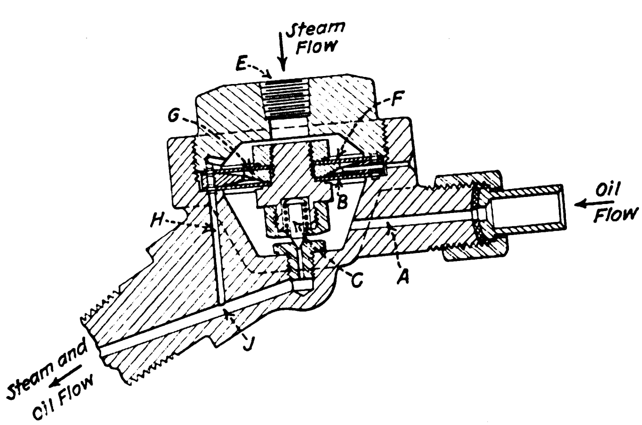
One yoke opens and closes the die head. The chasers can be removed without the use of a screw driver, by pressing down the stop lever and lifting the chasers out. The tool is hardened and ground and is completely inclosed. A grooved sleeve is provided for operation of the yoke in opening and closing the head. The chip clearance is large. The chasers extend beyond the front of the die head without overhang and are not held in place by screws.



Large chip clearance has been provided in the Geometric style K-D rotary opening die head

Double diaphragm lubricator check valve

A DOUBLE diaphragm lubricator check valve for locomotive service has been developed by the Madison-Kipp Corporation, Madison, Wis., particular features of the valve being that it is entirely automatic in operation; requires no adjustment or setting for pressures; operates by steam pressure differential rather than by spring tension which may vary, and is designed to give complete atomization of the oil.



Cross-section of Madison-Kipp double diaphragm check valve

The check valve has the usual connections to the steam pipe or valve chamber, and to the lubricator, also a steam connection on top of the check valve for operating the diaphragm and furnishing steam to atomize the oil. The operation of the valve is as follows:

Referring to the illustration, the oil from the lubricator is forced into the check valve passage *A* from which it passes into the check valve chamber and operates against the diaphragm *B* in order to raise the check member *C* from its seat. When the oil pressure is not operative, the check valve is kept closed by steam at boiler pressure entering at *E* and operating against the diaphragm *F*. Under such conditions it is not possible for the steam pressure in the oil line to open the check valve against the steam pressure at *F*, due to the fact that the steam pressure at *F* has a greater effective area to operate against on the diaphragm than is the case at *B*, Therefore, when the boiler pressure is 200 lb., approximately 250 lb. of oil pressure is required to raise the check member *C*.

The oil atomizing feature consists in bi-passing some of the steam from *E* at all times through the passage *H* and mixing it with the oil at *J*. The ports are proportioned to give extremely fine atomization of the oil which occurs even when the engine is drifting.

P & B self-protecting oil burner

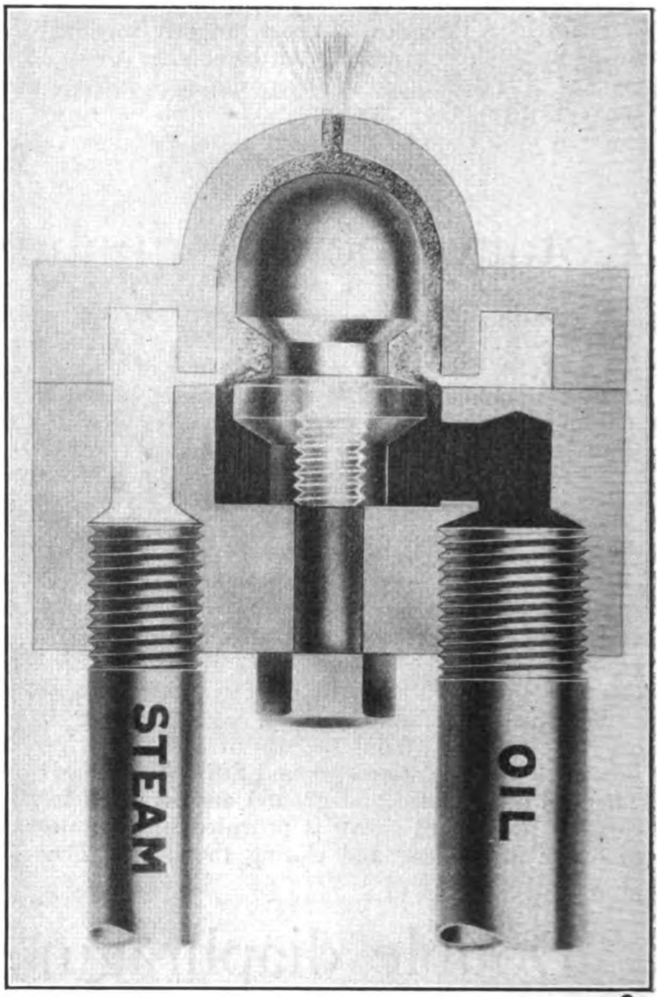
A SELF-PROTECTING oil burner which is said to use only 1.3 per cent steam has recently been placed on the market by F. Beers & Co., Federal Trust building, Newark, N. J. It has only three parts and is adaptable to any kind of flame to suit any type of furnace. It protects itself from overheating by absorbing the heat radiating through the cap into the steam used for atomizing.

The design of this burner is such that it causes the steam to break up the oil into very minute particles. The breaking up is done inside, not outside of the burner. Four inside steam jets are employed, all acting at right angles to four oil jets. Steam consumption is thereby reduced to a minimum.

The burner is of a compact design which gives it a number of advantages. It does not project far into the furnace, hence the danger of overheating, carbonizing, and clogging is minimized. Every inch saved in the length of the burner virtually adds an equal number of inches to the length of the furnace. There are no parts to adjust and get out of order. The correct size of oil and steam ports is determined by the pressures available and the capacity required.

In one test it is reported that a P & B burner, with 75 lb. oil pressure and 120 lb. steam, oil temperature 120 deg. F., 14 deg. Baume gravity, using four ¼-in. by 3/64 in. steam ports and four ¼-in. by 1/16-in. oil ports, with a ⅛ in. by 1 3/16 in. burner tip, actually developed 1,000 boiler hp. per hour, maximum. The same burner developed a minimum of 25 boiler hp. per hour, with a steady small fire. The burners can be altered for both larger and smaller capacity by changing the oil and steam ports and tip the openings.

The burner head is made of cast iron. Owing to accurate machining the two sections when bolted together by the four cap screws are steam and oil tight without the use of any gasket. The central plug is held in position by a single 5/16-in. cap screw and is also oil-tight without the use of a gasket. The plug is held in a central position so that equal amounts of mixture pass through all of the surrounding ports. At the same time equal amounts of steam pass through the ports from the steam section, impinging against the oil jets, and in the space surrounding the plugs, the oil becomes completely broken up, vaporized and mixed with the steam.



A cross-section of the P. & B. self-protecting oil burner

Model B 12-inch vertical shaper

THE Pratt & Whitney Company, Hartford, Conn., has placed on the market a 12-in. vertical shaper which has been developed to take the place of the old 10-in. model and to greatly extend its range. Operating convenience and the range of speeds and feeds are the outstanding features of this model. The three operating hand wheels are all located on the front of the machine. The feed reverse lever and the friction clutch lever are also within easy reach of the operator so that he has complete control of the machine without moving from the front of the machine. The convenience of the lever arrangement is shown in the illustration.

The basic principle of the vertical design remains unchanged in the 12-in. model. In accordance with modern practice the new model shaper is designed for either a built-in motor drive or a single pulley belt drive from a lineshaft. Either way the main drive pulley of the machine rotates at a constant speed of 440 r.p.m., so that power is used as efficiently as possible, regardless of the speed of cutting.

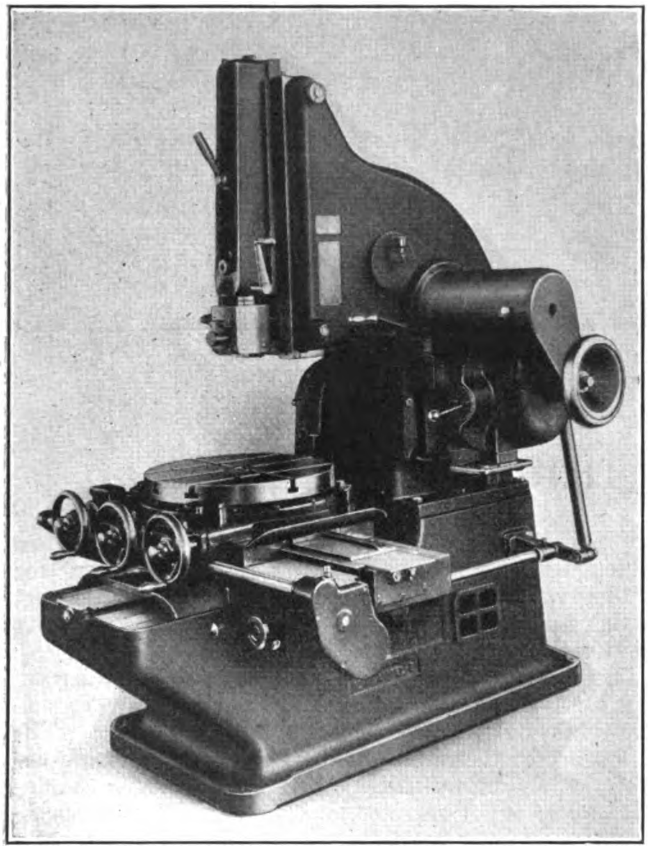
When arranged for individual motor drive a 5-hp. constant speed motor is mounted inside the bed. The floor space required for both the motor and belt-driven machines is, therefore, the same. The motor drives the large friction pulley at the side of the machine through a 3-in. belt. The belt tension is controlled by the screw adjustment of the hinged platform on which the motor is mounted. Space is provided on the column for whatever electrical control equipment is desired. The belt-driven machine requires no change other than the elimination of the few motor drive parts. In this case it is only necessary to belt the same driving pulley at the side of the machine to a lineshaft, using the same size of belt and the same pulley speed.

Power is controlled from the driving pulley by means of the friction clutch incorporated in it. This clutch is operated by a convenient lever on each size of the ram, which controls the motion of the machine at all times.

The lever has three positions: a working position, a neutral position and a third position which applies a brake for stopping the ram quickly. This friction clutch lever also actuates a segment and gear which provides a safety interlock to prevent any attempt to change the speed gears when they are in motion.

The power is taken into a gear box on the right side of the column. Four speeds and a neutral position are provided and an H-shift lever forms a convenient means of control. Power is taken from the gear box to the vertical ram by means of a large slotted eccentric and follower block which produces the slow power stroke and the quick return motion. An improved method of sight feed oil cup lubrication insures plenty of oil for the bearings at all times.

The ram slide and ram form a separate unit on the front of the column. The slide is heavily hinged at the top and has a heavy screw adjustment at the bottom so



Pratt & Whitney Model B, 12-in. vertical shaper designed for either motor or belt drive

that the entire unit may be swung to any angle desired up to 5 deg. and solidly locked in position. An angular scale is provided whereby the ram may be set and a new feature has been added which permits it to be returned to its true vertical position at once without additional adjustment.

The ram is thoroughly gibbed and is so designed that adjustments for wear are easily made. A handwheel attached to the gear box permits the ram to be easily moved through its entire travel for positioning at the start of a cut. The length of stroke of the ram is variable from zero to 12 in. by a lock nut adjustment on the end of the feed cam. The four speeds obtained from the gear box produce ram speeds of 22, 37, 56 and 90 strokes per minute.

The tool post is carried in a clapper so mounted that the thrust of the cut forces it rigidly against the head. This clapper permits the tool to clear the work on the return stroke. The tool post binder screw has been eliminated. The tool is held by drawing the tool post against it from the back This feature permits the tool post to pass over the work without interference as in no case does it project beyond the cutting edge of the tool. The tool head may be rotated a full 360 deg. and solidly clamped in any position.

Power feed for the machine is obtained from the feed cam on the upper right side of the column. This cam is driven by an extension of a shaft from the speed gear box so that it is always in correct relation with the speed of the ram. A side cam is used with a single rise which functions once for every stroke of the ram. The cam follower actuates a bell crank so that the feed is supplied by a rocker motion at the end of each stroke. The lever which connects the bell crank with the feed gear rod is adjustable on the crank for varying the amount of feed. This lever is made in the form of a safety device and consists of a sleeve containing a plunger and spring. The latter is stiff enough to transmit power for regular machine working conditions, but should the work or tool become jammed by careless handling, this plunger will simply pump up and down against the spring and no harm will result. An additional safety device is incorporated in removable cast iron guards which cover the feed cam and follower. A notched wheel and double pawl take the rocker motion delivered by the connecting rod to the notched wheel shaft and change it to an intermittent rotary motion. The feed gear box provides a forward, neutral and reverse feed drive by means of a bevel gear mechanism, and is controlled by a knob on the front of the bed convenient to the hand of the operator, the location of which is shown in the illustration.

A total transverse travel of 25 in. and a longitudinal travel of 25 in. are available. Handwheels and micrometer dials for hand traversing in either direction are provided and binders are furnished for locking both slides in position when desired.

The 24-in. rotary table provides ample surface for a wide range of work. It is provided with four indexing notches so that quick indexing may be had for surfaces to be machined at right angles to each other. Any other angle may be easily located by using the graduations provided on the table. A suitable handwheel, micrometer dial and binder are provided, and as all handwheels are entirely below the level of the table, there is no interference when placing large work on the table of the machine.

All handwheels are conveniently marked with arrows to show which motion is controlled by each wheel. The hand feed is disconnected and the power feed engaged by pushing in the knob on the handwheel, which operates a clutch. Each handwheel is provided with a micrometer dial which turns with both the hand and the power feeds. The range of feeds available is .0021 in. to .0833 in. for the transverse and longitudinal travels and .0043 in. to .1745 in. on a 10-in. radius for the rotary power feed, described in another paragraph.

The distance from the table top to the under side of the ram bearing is 14 in. and the maximum distance between the table and the ram itself is 24½ in. The tool post takes a tool ⅞ in. by 1⅝ in. The floor spaces occupied by the shaper with either belt or motor drive is 5 ft. by 7 ft. 2 in. and the overall height is 8 ft. 5 in. The machine with regular equipment weighs about 7,500 lb.

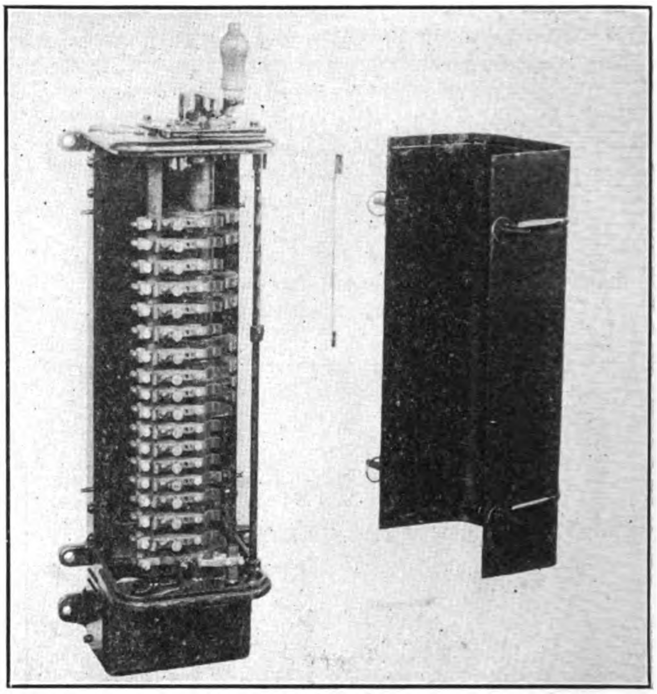
Drum controllers for machine tools

THE General Electric Company has recently placed on the market a new, completely standardized line of drum controllers, embodying new features of construction and comprising units for general purposes, crane hoist or machine tool applications, for either direct or alternating current. In each group several sizes have been provided to cover a wide range in motor ratings, the smaller sizes being suitable for wall mounting and those used for the larger motors being constructed for mounting on the floor.

A skeleton type of frame is used in the construction of these controllers. This consists of a cast cap plate and base, to which are hot riveted rectangular steel bars, thus making it unnecessary for the back of the switch to function as a framework for holding the top and bottom of the switch together. As a result, the switch is accessible from both back and front for the purpose of making adjustments, renewals, etc.

Operating handle mechanisms are interchangeable. A vertical operating lever or a spring return mechanism may easily be substituted for the horizontal lever with which the switch is equipped, by making use of another dial plate.

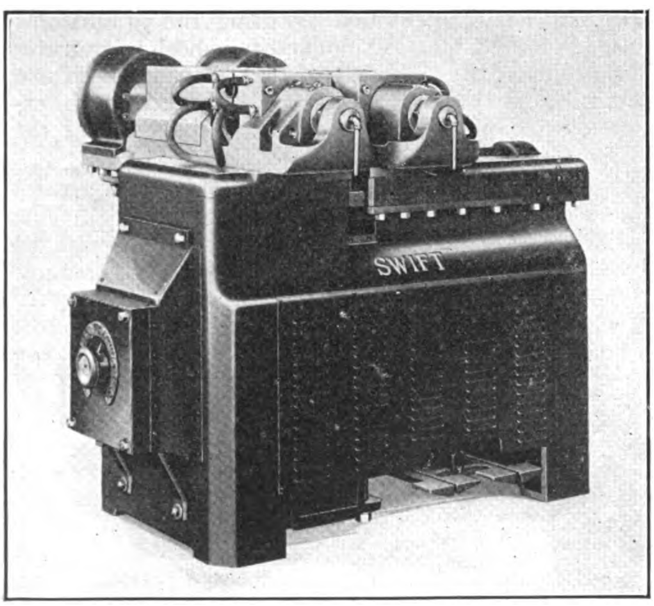
New style self-alineing contact fingers are used. By standardizing the renewable copper tips for all switches of the same capacity, renewal stocks will be reduced to a minimum. Where cross-arcing is likely to occur, adequate preventive barriers and blowouts are provided. Auxiliary contact fingers are provided for control circuits to the line protective switch. The arrangement of these circuits is designed to suit the service requirements of the installation.



Typical wall switch drum controller

Electric welder for flues and tubes

JOSEPH T. RYERSON & SONS, INC., Sixteenth and East Rockwell streets, Chicago, is marketing an electric flue welder recently developed by the Swift Electric Welder Company. Detroit, Mich. This machine was designed for safe-ending flues and also for the welding operations in reclaiming small pieces. With proper dies it can be used for any kind of butt welding. When not engaged on its regular work, it may be used for welding round or bar stock or for annealing, upsetting, heating and stretching, etc. The welder has a capacity for tubes in any size up to 6 in. in diameter.



The Swift electric welder which has a capacity for flues and tubes up to 6 in. in diameter

The welder is said to be flash proof, thus assuring long life to the winding and bearings. All moving surfaces slide on hardened and ground steel plates. The clamps are of the improved flash and slag proof adjustable type, sliding on hardened steel guide plates to minimize wear. Foot operated air cylinders leave the operator's hands free to handle the work. Three-fourths of a cubic foot of air at approximately 80 lb. pressure is required for a weld.

Two pairs of dies are used for each set. One set of dies handles work on both 2-in. and 3-in. tubes. On the large work a separate set of dies is required for each size of flues. All the dies are water cooled and have hardened steel guide plates to minimize wear.

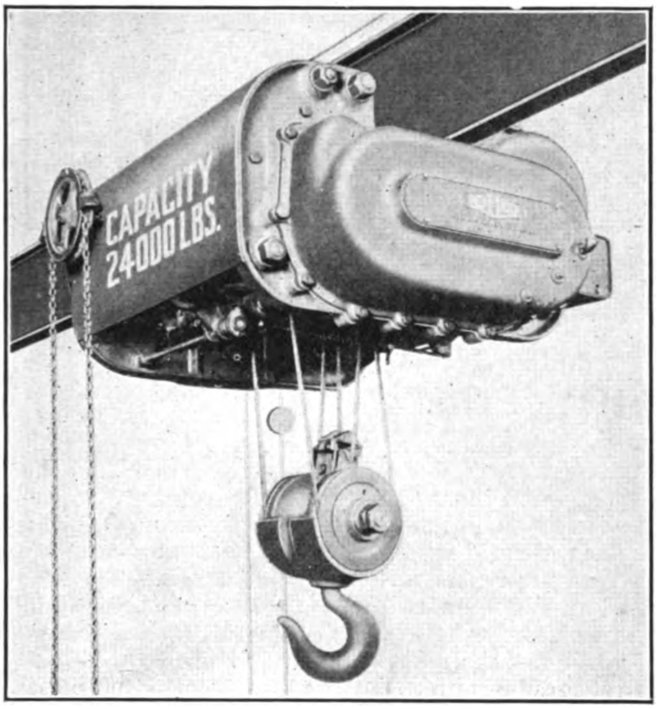
The machine is equipped with a pressure cylinder for pushing up the work. This cylinder may be connected either to a hydraulic accumulator, oil gear pump or a hand-operated oil-jack. A pressure of 800 lb. per sq. in. is required for 6-in. tubes, with proportionately less for smaller work. The volume required is .6 gal. per welding cycle.

The welder is operated by a remote control system, consisting of a contactor panel separately mounted and operated from a lighting circuit by a push button switch on the welder. By this method the power is entirely removed from the welder except at the instant of making the weld. This economizes on power and removes an ele-

ment of danger to the operator. The welder can be supplied for either 220- 440- or 550-volt primary circuit and preferably 60 cycles. The primary circuit is air-cooled; the secondary circuit, dies and die blocks are water cooled. The standard rating is 150 k. v. a. at an 85 per cent power factor.

New sizes of Lo-Hed electric hoists

Six electric monorail hoists, ranging in capacities from 3 to 12 tons, have recently been placed on the market by the American Engineering Company, Philadelphia, Pa., as additions to its line of Lo-Hed hoists. Each of the new hoists is made in types for bolt suspension, hand-geared trolley, motor trolley and cab control. Open cabs are provided for indoor use and closed cabs for outdoor service. The hoists can also be supplied with push-button control or remote control.



The 12-ton Lo-Hed hoist

These hoists, which are designated as Class J, embody the same principles of design that characterize the other models of Lo-Hed hoists, with such additional features as are made necessary by the higher speeds at which they operate and the heavier loads they are designed to handle. Rated capacities are 3, 5, 6, 8, 10 and 12 tons, so that the complete Lo-Hed line now includes hoists from ½ ton to 12-ton capacity.

In all Lo-Hed hoists the drum and motor are placed on opposite sides of the I-beam track, so that the load block can be drawn up between them until it almost touches the rail. This utilizes all the available headroom and enables these hoists to handle the large loads and to stack goods at a maximum height.

The hoist operates on standard I-beams, through switches and around curves. Hyatt roller bearings on the trolley wheels and ball thrust bearings between the wheels and the trolley frames, combined with the straight spur gear drive and the fact that the wheels on both sides of the I-beam are driven, make the hoist move easily along the rail. The trolley trucks are swiveled for going around curves of short radius.

The ball-bearing hoisting motor is totally enclosed and drives the drum by spur gears running in oil. Hyatt bearings are provided on the ends of the shafts. The working parts are accessible for inspection and care by removing the cover of the hoist. The compact design eliminates all need for long shafts. The motor and pinion can be removed as a unit without taking off the gear cover or draining the oil from the gears. Safety features include a factor of safety of five in the design of the hoist; upper limit stop and a quick-acting brake that is automatically applied the instant the current is turned off, either accidentally or intentionally.

Sixteen-inch geared-head lathe

A sixteen-in., geared head Rapid Production lathe is now being built by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, with automatic lubrication throughout. The headstock, feed and traverse mechanism and apron are all flood-lubricated and in addition, a submerged geared pump in the apron furnishes automatic forced lubrication to the carriage and cross-slide bearings. Hand-oiling is eliminated and no attention need be given to lubrication except to see that the proper oil level is maintained in the various units. Another feature of the machine is the use of Timken tapered roller bearings in the selective-speed geared headstock. The spindle, drive shaft and all intermediate shafts are mounted on bearings of this type.

A rapid power traverse for the carriage and cross-slide furnish maximum operating convenience and reduce the handling time and the time between cuts. The feed and the traverse to the carriage and the cross-slide in either direction are controlled through a single lever on the apron.

The drive is through a multiple-disk clutch in the driving pulley, and then through gear combinations to the spindle. The driving clutch embodies a quick-acting friction brake which is automatically engaged upon the release of the friction to bring the spindle to an instant stop. The friction is controlled by means of a handle on the front of the headstock. Six spindle speeds of from 47 to 450 r.p.m. are obtainable through two levers.

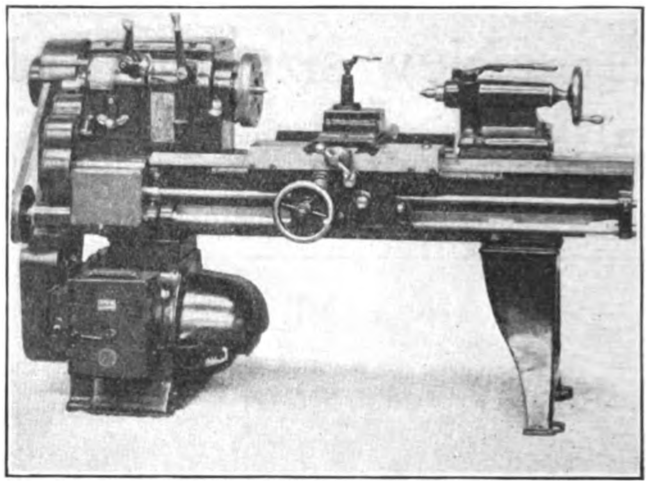
The drive for the geared feed mechanism is taken from one of the headstock intermediate shafts and delivered through a quadrant and system of change-gears to the feed shaft. Coarse feed changes are made through change-gears on the quadrant, and the intermediate fine changes by shifting a lever on the front of the headstock. Twenty-seven feeds, ranging from .003 in. to .108 in. per spindle revolution are available.

The rapid power traverse is incorporated in the feed mechanism and power is transmitted to the traverse shaft by belt from the driving pulley. The traverse is engaged by a lever on the apron, which shifts a double positive

jaw clutch, the traverse being effective both longitudinally for the carriage and transversely for the slide, in either direction. The same lever is also used to engage the longitudinal and cross feeds. The feed and traverse are interlocked so that they cannot be engaged at the same time.

The gearing in the apron is very simple; there are only six gears. All shafts have bearings at the front and rear. The apron handwheel is provided with a positive clutch which can be disengaged so that the handwheel will not revolve while the feed or power traverse is engaged. The bed is of the heavy-duty type with the compensating vee construction on the front shear. This construction provides a large carriage bearing area and insures lasting alinement. It furnishes a thrust bearing approximately at right angles to the tool pressure on any diameter of work within the swing of the machine. The tailstock is of the set-over type, and the top is graduated so that the amount of set-over may be accurately determined. It is clamped in position on the bed by two heavy bolts.

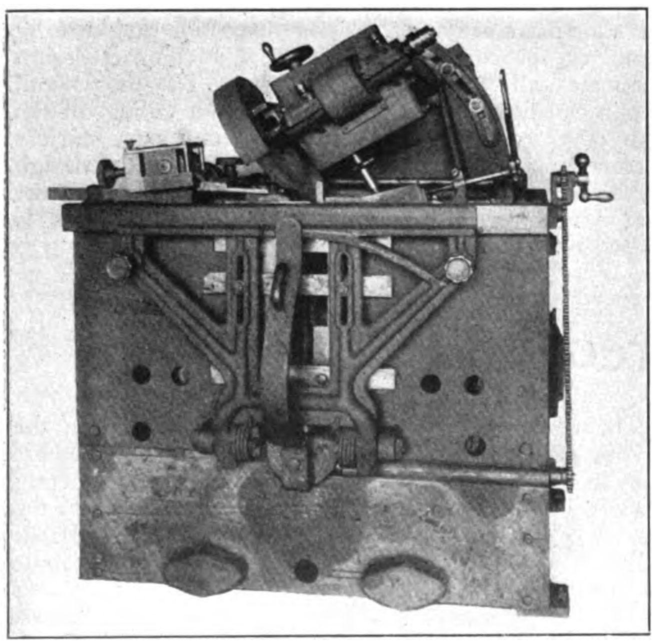
Either a geared or belted constant-speed motor drive, for alternating or direct current may be furnished. In the geared motor drive, the motor is mounted on top of the headstock, while in the belted motor drive, it is housed in the base of the front cabinet leg where it is completely enclosed and out of the way. A 5-hp. motor running at 1,200 r.p.m. is recommended.



LeBlond 16-in lathe which is automatically lubricated throughout

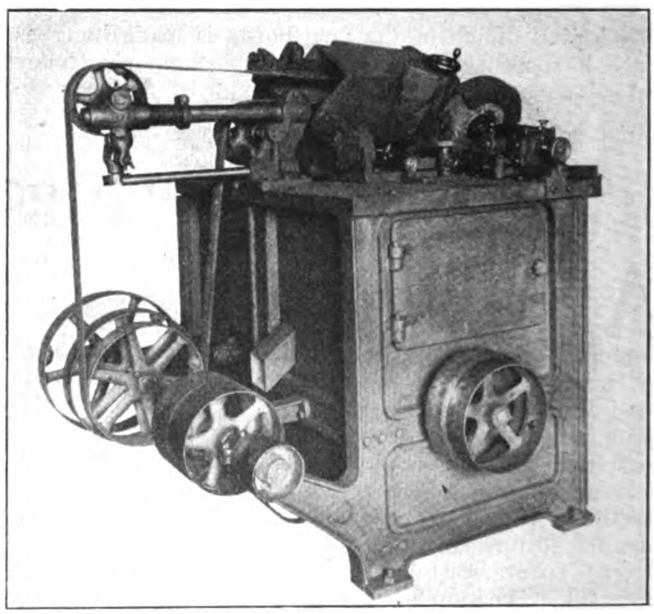
Automatic band saw sharpener

THE essential improvement incorporated in the automatic band saw sharpener recently developed by the Machinery Company of America, Big Rapids, Mich., is the timing of the feeding and grinding movements. In the older type machines, the action of the grinding head had to be timed to allow the feed finger to pass out of the throat of the tooth before the grinding wheel could engage the tooth point and throat. This not only required that the grinding wheel should remain suspended above the tooth a large percentage of the grinding interval, but caused a much more choppy, abrupt action of the wheel on the tooth during the actual grinding, and made the grinding contact much more severe on both the wheel and the saw, as well as on the machine mechanism.



Automatic band saw sharpener for saws 10 to 16 in. wide

The new action allows about 50 per cent more time for the wheel to engage the tooth, and thus enables a much smoother, less severe grinding action. The feed finger, after feeding each tooth to the grinding position, is immediately withdrawn inside the saw leaving the entire tooth free for the grinding wheel so that the wheel can engage the entire tooth from the point to the throat and up the back with a steady smooth movement of machine tool accuracy and precision which enables the perfect shaping and pointing of the teeth.



Rear view of the No. 188 automatic band saw sharpener

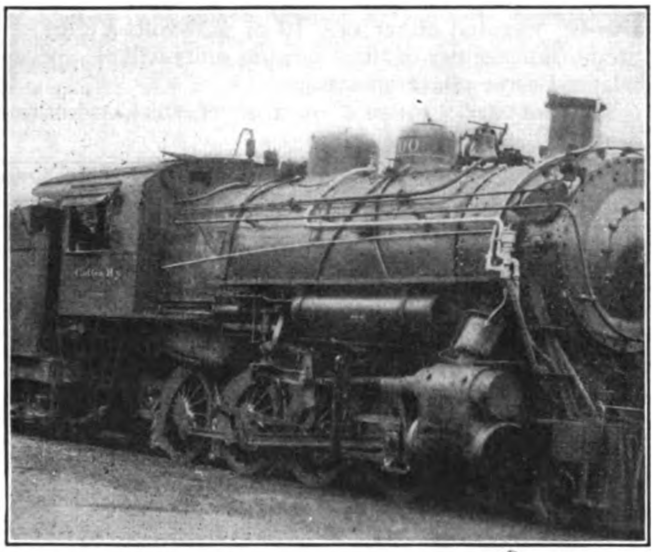
A straight line thrust of the feed finger is used for feeding the saw. A high-speed steel adjustable finger is

used to engage the face of the teeth at any point. The lift arm and feed arm pivoting and connections are designed for convenience of operation and maximum adjustment for a wide variety of service, with the length of the grinding head and feed finger movements readily adjustable to secure the grinding actions desired.

The head spindle carrying the arbor and grinding wheel runs in ball bearing. The grinding wheel mandrel is equipped with a ring oiler. An adjustment to afford any required bevel on the cut-off saws may be made without stopping the machine. All the parts are accessible for adjustment and repairs.

Automatic drifting throttle and relief valve

AN automatic drifting throttle and reilef valve has been designed and patented by W. W. Boulineau, master mechanic on the Central of Georgia at Cedartown, Ga., and is being sold by the Walraven Company, Atlanta, Ga. It has been thoroughly tested on Central of Georgia locomotives which tests results are



The valve is located on the right side of the boiler near the front end

said to have shown a saving in fuel consumption, increased mileage of cylinder packing rings, a reduction in carbon formation in the cylinders and valve chambers and a reduction in the cost of lubrication.

The drifting valve consists of two large chambers, one at each end of the valve, joined together by a long chamber of smaller diameter. The top chamber, which contains the floating operation piston, has an outlet to which is connected a ⅜-in. pipe leading to a three-way valve in the cab. The bottom chamber, which contains the large differential attached piston, has an outlet for a ⅜-in. pipe which leads to the steam pipe. The middle chamber contains three openings. The one admits steam from the steam dome, the other steam from the cylinders and the third is the connection to the atmosphere or exhaust. This cylinder contains three pistons mounted on a common piston rod, at the lower end of which is attached the differential piston, at the upper end the smaller differential piston and in the middle two piston valves.

When the two piston valves are over the opening leading to the cylinders, the differential pistons are balanced by steam entering from the steam dome underneath the small piston and by steam entering from the steam pipe underneath the large piston. The device is then in the running position.

When the main throttle is closed a partial vacuum is formed in the lower chamber by means of the ½-in. pipe connection from the locomotive valve chamber. Atmospheric pressure then acts against the opposite side of the large differential piston, thus moving it from its running position. In this position steam is admitted to the cylinders from the dome. The valve is now in the drifting position.

The valves are moved to the relief position by the steam in the operating valve chamber being exhausted to the atmosphere through the ⅜-in. pipe leading out of the top of the chamber and the three-way valve in the cab operated by the engineman together with the steam from the valve chambers acting against the large differential piston. The steam from the cylinders will then pass to the atmosphere through the pipe leading from the cylinder out through the pipe leading to the exhaust. The valve will remain in this position until steam is again admitted to the chamber containing the floating piston by the operation of the three-way valve.

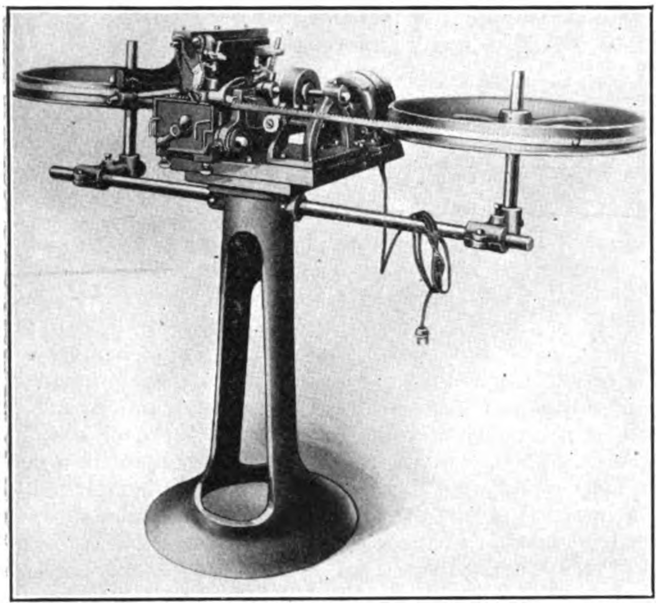
Band saw filer and setter

THE Wardwell Manufacturing Company, 110-112 Hamilton avenue, Cleveland, Ohio, has recently developed a combination band saw filer and setter designed to file, set and joint band saw blades in one operation. The machine is constructed in types for use as a bench machine or it may be mounted on a pedestal. One model, K, is used for woodworking band saw blades. It will handle saws from ⅛ in. to 2 in. in width, with from 2 to 15 teeth to the inch. Model K-2 is for medium or spring tempered metal cutting band saws from ⅛ in. to 2 in. wide, up to 26 teeth to the inch. Either model may be arranged, for use with direct-motor or belt drive as desired.

The machine shown in the illustration is a pedestal-mounted direct motor driven model equipped with adjustable wheels for carrying the saw being resharpened. A door, held by one large wing nut, may be removed, which opens the entire front of the machine for inserting the saw blade. This door forms the front jaw of a vise for holding the saw, the rear jaw of which is acted upon by double cams which are adjustable.

Power is transmitted through a flexible coupling to a worm and gear. The motor worm shaft is fitted with a ball thrust bearing. The filing arm, which runs in bronze-lined guides, receives its motion from a hardened steel cam working on a chilled casting. The roller and cam screw are hardened and ground. The file is rigidly set in the filing arms and the adjustment controls the

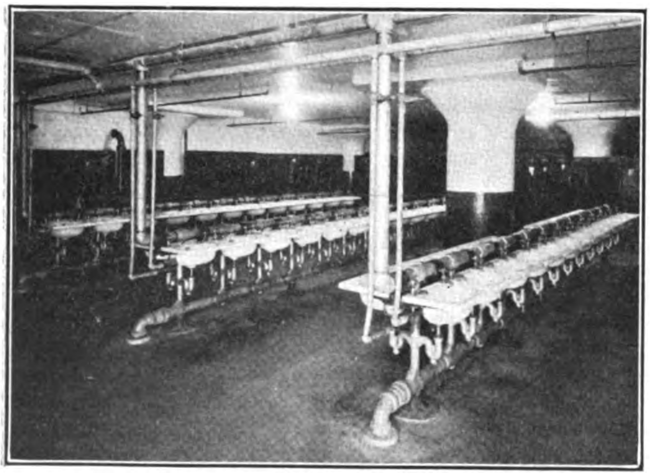
depth of cut. This is said to cause the teeth in hard spots in the saw blade to be cut to the same depth as in the soft spots with a consequent cleaning out of the gullet under all conditions of the steel. It is said to be possible to file and set saws with this machine at the rate of 70 teeth a minute.



Pedestal-mounted Wardwell saw filer with adjustable wheels for carrying the saw blade

Individual sanitary washbowls

THE accompanying illustration shows three batteries of individual sanitary washbowls, each with a common water waste. The bowls are of heavily vitrified porcelain enamel and hold two gallons of water. The most modern type of plumbing construction, such as waste connection with recess joints, etc., has been followed. The upright from the top of the structure to and below the waste pipe is one casting, including the traps, thus reducing the number of joints to a minimum. The structure, erected, forms a complete unit. All that is necessary is to connect the water supply, vent and waste.



Three double rows of wash bowls, each battery connected to a common water supply and waste pipe

There is room enough at each bowl for every man without crowding. The width of two rows of washbowls placed back to back is 34 in. x 5/8 in. This equipment is manufactured by the Manufacturing Equipment & Engineering Company, Boston, Mass.

Metal melting pot with a large capacity

A METAL melting pot, with a capacity of approximately 1,000 lb. has recently been placed on the market by the General Electric Company, Schenectady, N. Y. This pot, utilizing the electric heating principle, is practically the same as other standard General Electric melting pots except that three cast-in, sheath wire immersion heating units are used instead of two heating units of similar design.

Each heating unit is rated at five kilowatts. The pot may be operated either on 110 or 220-volt. a.c. or d.c. circuits and the use of three heating units will also permit balanced three-phase operation.

The pot itself consists of a sheet steel, cylindrical casing in which is supported a cast-iron crucible, 18-in. in diameter by 15 in. in depth inside, and 29 in. in diameter by 31 in. in depth outside. The space between the casing and the crucible, measuring about three inches, contains a compact heat insulator. The leads of the heating units are brought over the top of the pot into a connection box fixed to the unit itself.

An electric metal melting pot with an approximate capacity of 1,000 lb.

Melting pots of this type are designed for melting lead, babbitt, tin, solder and similar alloys or metals, except spelter or zinc, at temperatures not exceeding 850 deg. F.

Full-automatic control is recommended, consisting of a standard automatic control panel and a temperature control instrument equipped with a special bulb for metal immersion. Separate heating units may be installed in existing installations of melting pots where dimensions permit and where the required temperatures do not exceed 850 deg. F.

News of the Month

PROMOTIONS AND APPOINTMENTS · I.C.C. · THE SUPPLY TRADE · CLUB AND ASSOCIATION NEWS · NEW TRADE PUBLICATIONS · NEW SHOPS

Rail motor cars for passenger traffic on the Victorian Railways are being used more and more extensively. The railway commissioners are considering the adoption of oil-electric drive coaches to take the place of the single-ended gasoline coaches of comparatively low power which have been in use for some time.

The first complete locomotive to be constructed in Rumania was delivered in September to the Rumanian State Railways. It was built entirely at the Reshitza Metallurgical Works. The locomotive is a standard-gage, oil-burning type, weighing 88,000 kilograms. The Reshitza works are now equipped to turn out 80 locomotives of this type per annum, which means, it is claimed, that Rumania will no longer need to import locomotives.

Representatives of the shop crafts of the International-Great Northern and representatives of the road organized a system board of adjustment for the differences which arise among employees and employers, at Palestine, Tex., on October 13. The employees and the management have equal representation on this board and the board will decide disputes growing out of personal grievances or applications of shop-crafts schedules and practices in cases which cannot be adjusted through customary channels.

The Pennsylvania, on Wednesday of this week, announced that the shopmen of the company, numbering more than 43,000 mechanics, helpers and apprentices had been granted an advance in pay of three cents an hour effective October 16, bringing the general rate up to 76 cents, the same as that granted by the New York Central September 1. This advance follows several weeks' conference at Pittsburgh. The committees representing the employees were elected by the employees themselves from among their own number.

Court news

Automatic couplers under safety appliance act.—The Circuit Court of Appeals, Sixth Circuit, holds that an employee may recover for an injury sustained through failure to equip a car with automatic couplers as required by the Safety Appliance Act although neither he nor the car was at the time engaged in interstate commerce.—Detroit United Ry. v. Craven, 13 F. (2d) 352.

Wage statistics for July

The number of employees reported by Class I steam roads to the Interstate Commerce Commission as of the middle of the month of July, 1926, was 1,857,219, an increase of 23,598, or 1.3 per cent, over the number for June, 1926. The total compensation shows an increase of $5,562,159, or 2.2 per cent. The greater percentage increase in compensation is due to an increase in the number of hours worked per employee, and a larger proportion of overtime.

Compared with the returns for the corresponding month last year, the number of employees reported in July, 1926, increased 3.4 per cent, and the total compensation increased 3.6 per cent.

Equipment installed

Class I railroads during the first eight months this year installed in service 1,440 locomotives, the Car Service Division of the American Railway Association has announced. This was an increase of 227 over the number installed during the corresponding period last year but 57 below 1924. Locomotives on order on September 1 totaled 533, compared with 193 on the same date last year and 324 in 1924.

Freight cars installed in service during the first eight months totaled 77,225, a decrease of 28,221 under the corresponding period in 1925, and 27,731 under 1924. Of these 10,967 were placed in service during August, including 4,619 box cars, 5,145 coal cars and 679 refrigerator cars.

Class I railroads on September 1 had 20,251 freight cars on order compared with 20,863 on the same date last year and 41,476 in 1924. These figures as to freight cars and locomotives include new and leased equipment.

Car inspector submits winning safety slogan

In a safety slogan contest conducted by the Pennsylvania at its east car shops at Ft. Wayne, Ind., more than 500 slogans were submitted by the employees. The winning slogan was one submitted by a car inspector—

> THE WORK IS DANGEROUS, THE HOSPITAL IS WORSE;
> LET'S GET TOGETHER AND BOOST SAFETY FIRST.

Other slogans winning places in the contest were, "One way, the right way, the safety way," submitted by a machine operator; "A safe day's work means a full day's pay, and a chance to prepare for a rainy day," by a car repair helper; and "Safety today for service tomorrow," by a car repair helper.

The winning slogans will be painted within large keystones on the walls of the shop buildings as constant reminders to the employees to eliminate accidents. A committee of 12 shopmen acted as judges.

Meetings and Conventions

The Louisiana Car Department Association was recently organized in New Orleans, La., by car foreman, car inspectors, etc., the chartered members totalling 140. The association holds meetings on the third Thursday of each month. Besides car foremen, car inspectors, etc., railway supply men are eligible for membership. Officers of the club are Ugo Mendall, president; T. L. Butvher, first vice-president; E. A. Banks, second vice-president; J. E. Durand, treasurer; L. Brownlee, secretary, and J. D. Ernst, chairman of the publicity committee.

International Conference on Bituminous Coal to Be Held at Pittsburgh

The program for the International Conference on Bituminous Coal to be held at the Carnegie Institute of Technology, Pittsburgh, Pa., November 15 to 18, includes quite a number of outstanding engineers in both Europe and America. Among those who have accepted invitations to speak at this conference are Dr. Friedrich Bergius of Heidelberg, Germany, inventor of the Bergin method of producing petroleum from coal; Jean Bing, director of technical service, Coal Tar Products and Distillers Association, Paris, France; Dr. C. H. Lander, director of fuel research of the Department of Scientific and Industrial Research, England; and Geoffrey M. Gill, fuel technologist and gas specialist, London, England. In addition, A. C. Fieldner, chief chemist of the U. S. Bureau of Mines and superintendent of the Pittsburgh Experimental Station; Professor S. W. Parr, University of Illinois; and Osborn Monnett, smokeless fuel specialist of Chicago, will speak. Sectional meetings will be devoted to the subjects of smokeless fuel, power, high temperature distillation, fertilizers, gasification and coal tar utilization.

Subjects that should be of interest to railroad men is a paper by Marius Campbell, U. S. Geological Survey, Washington, D. C. on "Our coal supply, its quantity, quality and distribution," which is scheduled for Monday, November 15; a paper by Jean Bing on "The technical and commercial phases of coal utilization," which is scheduled for Tuesday; and the session of the smokeless fuel section to be held at 9:30 a. m., Wednesday. Three papers, one on "The economic aspects of the pre-treatment of coal for smokeless fuel," by Dr. Horace C. Porter, consulting chemical engineer, Philadelphia; "Smokeless fuel," by O. P. Hood, chief mechanical engineer, U. S. Bureau of Mines, Washington, D. C.; "Smoke problem of cities," by Osborn Monnett, will be presented at the session of the smokeless fuel section.

Exposition of Power and Mechanical Engineering to be held December 6 to 11

The fifth national exposition of Power and Mechanical Engineering, including heating and ventilating, will be held December 6 to 11, 1926, at the Grand Central Palace, Lexington avenue and Forty Sixth street, New York. This is during the same week as the annual meeting of the American Society of Mechanical Engineers, which meets December 6 to 9, inclusive and the American Society of Refrigerating Engineers, which will hold its sessions at the Hotel Astor for three days starting Tuesday, December 7. The educational value of the exposition is being developed as far as possible, as this annual event brings together not only the leaders in engineering and industry, but a considerable number of the general public who desire up-to-date information about developments in applied science. The exhibits themselves will consist largely of working units or models. In addition, a complete program of motion pictures has been provided showing a number of the larger and more recent developments in engineering. One of the exhibits will be under the auspices of the Museum of the Peaceful Arts, which is engaged in the development of plans for an industrial museum in New York City.

Fall meeting American Welding Society

Technical sessions, exhibitions and demonstrations will be held in connection with the annual fall meeting of the American Welding Society at the Broadway Auditorium, Buffalo, N. Y., November 16, 17, 18 and 19. A large variety of welded products will be a unique feature of the exposition of welding apparatus and supplies which will open on Tuesday afternoon, November 16. The technical sessions will begin Wednesday morning at 10 a. m. During these sessions the progress made by the welding research department of the American Welding Society (American Bureau of Welding) will be discussed. The program for the meeting is as follows:

WEDNESDAY, NOVEMBER 17—MORNING

Welding of Locomotive Parts, by M. Gjersten, master welder, Northern Pacific Company.
Organization of Welding on the Railroad, by F. H. Williams, assistant test engineer, Canadian National.

AFTERNOON

Comparative Tests on Arc and Riveted Structural Members, by A. M. Candy, general engineering department, Westinghouse Electric & Manufacturing Company.
Tests on Welded Roof Truss, by H. H. Moss, Linde Air Products Company.

THURSDAY, NOVEMBER 18—MORNING

Welding Science in the Engineering Curriculum of Universities, by Prof. G. J. Hoffman, Purdue University; Prof. B. L. Lucas, Mississippi Agriculture and Mechanical College; Prof. S. T. Hart, Syracuse University; Professor deZafra, New York University; Prof. R. D. Rickley, Ohio State University; Prof. F. V. Larkin, Lehigh University.

AFTERNOON

Welding Wire Specifications Committee, C. A. McCune, chairman.
Meeting of the American Bureau of Welding.
Dinner dance.

FRIDAY, NOVEMBER 19—MORNING

Short technical session on Welding in a Gaseous Atmosphere, including demonstrations, and exhibitions will be made by P. P. Alexander and R. A. Weinman, of the General Electric Company.
Meeting of Board of Directors.

AFTERNOON

Inspection trip to Niagara Falls Power House.

Mechanical division, A. R. A., adds new subjects for committee work

Two new committees, one on Automotive Rolling Stock, and one on Lubrication of Cars and Locomotives, have been added to the list of standing committees which will serve the Mechanical Division of the American Railway Association until June, 1927, according to Circular No. DV-486 which gives the complete personnel of all committees for the coming year. The list of standing committees, together with their chairmen, is as follows:

A—Arbitration—T. W. Demarest, general superintendent motive power, Northwest Region, Pennsylvania System, Chicago.
A-1—Prices for Labor and Materials—A. E. Calkins, superintendent rolling stock, New York Central, New York.
B—Autogenous and Electric Welding—J. T. Wallis, chief motive power, Pennsylvania System, Philadelphia, Pa.
C—Car Construction—W. F. Kiesel, Jr., mechanical engineer, Pennsylvania System, Altoona, Pa.
C-1—Brakes and Brake Equipment—G. H. Wood, general air brake instructor, Atchison, Topeka & Santa Fe, Topeka, Kan.
C-2—Couplers and Draft Gears—R. L. Kleine, assistant chief motive power, Pennsylvania System, Philadelphia, Pa.
D—Design of Shops and Engine Terminals—W. A. Callison, superintendent motive power, Chicago, Indianapolis & Louisville, LaFayette, Ind.
E—Electric Rolling Stock—L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul, Chicago, Ill.
F—Loading Rules—R. L. Kleine, assistant chief motive power, Pennsylvania System, Philadelphia, Pa.
G—Locomotive and Car Lighting—W. E. Dunham, superintendent car department, Chicago & North Western, Chicago.
H—Locomotive Design and Construction—H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western, Chicago.
I—Safety Appliances—C. E. Chambers, superintendent motive power and equipment, Central of New Jersey, Jersey City, N. J.
J—Specifications and Tests for Materials—F. M. Waring, engineer of tests, Pennsylvania System, Altoona, Pa.
K—Tank Cars—A. G. Trumbull, chief mechanical engineer, Erie, New York.
L—Wheels—C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe, Chicago.
M—Automotive Rolling Stock—C. E. Brooks, chief motive power, Canadian National, Montreal, Canada.
N—Lubrication of Cars and Locomotives—W. O. Forman, mechanical superintendent, Boston & Maine, Boston, Mass.

A. S. M. E. annual meeting

The annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Societies' building, 29 West Thirty-ninth street, New York, December 6 to 9, inclusive. The regular council meeting and conference of local sections delegates will be held on Monday, December 6. The various sectional meetings will be held on the succeeding days, the following tentative program having been arranged:

TUESDAY, DECEMBER 7.

9:30 a.m.—Industrial Power Division.
Textile Division.
Wood Industries Division.
Power Test Code Public Hearing.
2:00 p.m.—Fuels—Smoke Abatement.
Railroad Division.
Joint session with A. S. R. E. Program arranged by sub-committee on Heat Transmission of N. R. C.
General (I).
4:30 p.m.—Robert Henry Thurston Lecture.
Evening—Presidential address and reception; John Fritz medal award to Dr. Elmer A. Sperry.

WEDNESDAY, DECEMBER 8

9:30 a.m.—Fuels—By-product Processing of Coal.
Machine Shop Practice Division (I) jointly with Research Sub-committee on Cutting and Forming of Metals.
Material Handling Division.
General (II).
2:00 p.m.—Business meeting and general session.
3:00 p.m.—Education and Training for the Industries.
Student Branch Conference.
Steam Tables Research.
3:30 p.m.—Ladies' tea.
Evening—Annual dinner.

THURSDAY, DECEMBER 9

9:30 a.m.—Central Station Power Division.
Management Division (I).
Machine Shop Practice Division (II)
Aeronautic Division.
2:00 p.m.—Management Division (II), jointly with Taylor Society.
Oil and Gas Power Division.
Springs—Open session of Special Research Committee on Mechanical Springs.
Petroleum Division.
Power—Jointly with Research Sub-committee on Boiler Feed-water Studies.
4:30 p.m.—Henry Robinson Towne Lecture.
Evening—College Reunions.

At the railroad session at 2 p. m. Tuesday, papers will be read on The Use of High Pressure Steam in Locomotives, by E. C. Schmidt, professor railway engineering department, University of Illinois, Urbana, Ill., and J. M. Snodgrass, professor railway mechanical engineering, University of Illinois, and on Balancing Factors in Use and Obligations Covering Ownership of Freight Train Cars, by L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul, Chicago. Also at the second management session at two o'clock Thursday afternoon, a paper on Railroad Organization will be presented by J. C. Clark, of the staff of Industrial Relations Counsellors, Inc.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer,* 30 Church St., New York. Annual meeting December 6 to 9.

AMERICAN SOCIETY FOR STEEL TREATMENT.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham Y. M. C. A. Building.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting November 9. Paper on transportation will be read by C. R. Moore, general superintendent transportation, Canadian National, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting November 8. Paper on wheels will be read by C. T. Ripley of the Atchison, Topeka & Santa Fe.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St. New York, N. Y. Regular meetings, second Thursday each month, except June, July and August, Hotel Statler, Buffalo, N. Y. Next meeting November 11. Lecture will be given on the story of compressed air, with five reel film. Will be preceded by talk on Oxygen, the Wonder Worker, by C. E. Harcke, with interesting experiments with liquid oxygen.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting November 9, Hotel Gibson, Cincinnati.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILMAY FUEL ASSOCIATION.—L. G. Plant Railway Exchange, 80 E. Jackson boulevard, Chicago. Annual convention May 10 to 13, 1926, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Rve., Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting November 9. Canadian night. W. M. Neal, assistant to vice-president, Canadian Pacific, will speak.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting November 19. Electrical night.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting November 11, Palace Hotel, San Francisco. Annual Associate Members night. All associate members will be given an opportunity to speak briefly upon any subject he may choose.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting November 12, Statler Hotel. Paper on rapid transit will be presented by C. E. Smith, consulting engineer, City of St. Louis.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting November 18, Ansley Hotel, Atlanta.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—C. Kimball, Inman shops, Southern, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Pyle National Company, Chicago, will construct a one-story plant, 22 ft. by 61 ft.

J. P. Carney, sales service engineer of the Grip Nut Company, Chicago, died on October 16 at Fond du Lac, Wis.

The Air Reduction Company, Inc., New York, has acquired all the assets of the Dayton Oxygen & Hydrogen Products Company, Dayton, Ohio.

J. R. Brandt has joined the Cleveland, Ohio, office of the Bridgeport Brass Company as raw material salesman in the Pittsburgh territory and parts of Ohio.

The Geometric Tool Company, New Haven, Conn., has appointed R. S. Stokvis & Fils, 20 Rue des Petits Hotels, Paris, France, as its exclusive agent for France.

Charles F. deBrunner has been appointed manager of the newly created plate and structural division of the North American Car Corporation, with headquarters at Tulsa, Okla.

Evan J. Parker, formerly of the Morgan Engineering Works, Alliance, Ohio, has been placed in charge of the sales promotion division of the Northern Engineering Works, Detroit, Mich.

The Davis Brake Beam Company, Pittsburgh, Pa., has discontinued its Roanoke, Va., office and future business in that territory will be taken care of by the general sales office at Pittsburgh.

The name of the Wayne Tank & Pump Company, Fort Wayne, Ind., has been changed to the Wayne Company. The change is in name only and in no way affects the business status or policies of the company.

R. C. Brower of the Automotive and Industrial Machinery Sales division of the Timken Roller Bearing Service and Sales Company, has been promoted to general manager, with headquarters at Canton, Ohio.

George Boehner has joined the sales organization of the American Hammered Piston Ring Company, with headquarters at Minneapolis, Minn. Mr. Boehner's territory will include Minnesota and North and South Dakota.

F. R. Pfaff, assistant advertising manager of Albert Pick & Company, has been appointed advertising manager of the Independent Pneumatic Tool Company, Chicago, to succeed Frank F. Leavenworth, resigned, to engage in other business.

The Parkesburg Iron Company, Parkesburg, Pa., will temporarily suspend the manufacture of charcoal iron boiler tubes in order to pursue plans for the diversification of its products. Changes in facilities also are to be made.

George E. Tyson, who for the past twelve years has been in the production department of the Reading Iron Company, Reading, Pa., has been appointed representative in the Reading territory. Mr. Tyson's headquarters are in the general offices of the company at Reading.

George E. Watts, 1523 Chandler building, Atlanta, Ga., has been appointed special representative of the J. S. Coffin, Jr., Company, Jersey City, N. J. For 18 years prior to his association with this company he was the southern representative of the Duff Manufacturing Company.

Charles C. Phelps, 473 Getty avenue, Paterson, N. J., has been appointed to handle the Marley superheater in New York City and Northern New Jersey. This superheater is made by the Power Plant Equipment Company, Kansas City, Mo., and is especially designed for use with horizontal return tubular boilers and other boilers of the fire tube type.

The North American Car Corporation, Chicago, has acquired control of the Palace Poultry Car Company, Chicago. Officers of the new company are: President, Erwin R. Brigham, vice-president of the North American Car Corporation; vice-president and general manager, I. V. Edgerton, vice-president and general

manager of the Palace Poultry Car Company; and secretary-treasurer, N. M. Stott, assistant secretary of the North American Car Corporation.

J. C. Morrell, formerly in the automotive division of the Westinghouse Air Brake Company and later assistant to district engineer of the same company and the Westinghouse Traction Brake Company, has been appointed representative of both companies, with office at New York.

Leland Brooks, formerly vice-president and treasurer of the Franklin Railway Supply Company, Ltd., Montreal, has been appointed special representative of the Worthington Pump & Machinery Corporation, with headquarters at Chicago. In addition to other duties Mr. Brooks will handle railroad sales in Canada.

E. C. Sicardi, president of the Union Tank Car Company, at New York, retired recently, after a service of about 36 years. E. L. Gridley, treasurer, has been elected a vice-president and secretary, with headquarters at Chicago. The executive and general offices of this company have been moved from New York City to 134 North La Salle street, Chicago.

R. E. Prussing, for many years district sales manager of the Whiting Corporation at Detroit, Mich., has taken up duties at the main office, Harvey, Ill. W. R. Hans, district manager at Buffalo, N. Y., succeeds Mr. Prussing at Detroit. Sales in the Buffalo territory will hereafter be handled by C. G. Crewson, Arthur E. Smith, and associates, Industrial Equipment Company, 306 Jackson building, Buffalo.

James H. McNulty, president of Pratt & Lambert, Inc., Buffalo, N. Y., died on October 17 from injuries received in an automobile accident on the day previous, near Buffalo. Mr. McNulty was a banker, took an active interest in civic affairs and was well known in the paint and varnish industry, having served as president of the National Varnish Manufacturers' Association in 1914. He first entered the service of Pratt & Lambert, Inc., in 1892 and was steadily promoted until he became president of the company in 1917.

W. H. Winterrowd, assistant to the president of the Lima Locomotive Works, Inc., has been elected a vice-president, with headquarters at New York. Mr. Winterrowd was born on April 2, 1884, at Hope, Ind. He attended the public schools at Shelbyville, Ind., and is a graduate of Purdue University, Class of 1907. During his college vacations, Mr. Winterrowd was employed as a blacksmith's helper on the Lake Erie & Western at Lima, Ohio, and as a car and air brake repairman on the Pennsylvania Lines West, at Dennison, Ohio. After graduation he obtained employment as a special apprentice on the Lake Shore & Michigan Southern, and in 1908 entered the service of the Lake Erie, Alliance & Wheeling as enginehouse foreman at Alliance, Ohio. In 1909 he became night enginehouse foreman of the Lake Shore & Michigan Southern at Youngstown, Ohio, and in 1910 was promoted to roundhouse foreman at Cleveland. A second promotion later in the same year made him assistant to the mechanical engineer. From September, 1912, to 1915, he was mechanical engineer of the Canadian Pacific, during the latter year being appointed assistant chief mechanical engineer, and in 1918, chief mechanical engineer, in which position he remained until 1923 when he was appointed assistant to the president of the Lima Locomotive Works. Mr. Winterrowd was at one time a member of the General Committee of the American Railway Association and is a member of the American Society of Mechanical Engineers.

W. H. Winterrowd

Gerald Firth, for the past eight years works manager of the Firth-Sterling Steel Company, McKeesport, Pa., has been appointed general manager. He was born on December 16, 1886, at Sheffield, England, and was educated at Uppingham School and at Trinity College, Cambridge. His ancestors have been connected with the steel business since 1842 in England and 1855 in the United States. The Firth-Sterling Steel Company was organized in 1896 at McKeesport, Pa., to manufacture fine steel products including high grade tool steel. In February, 1910, Gerald Firth went to the Firth-Sterling Steel Company and was engaged in investigating the requirements of the business in the United States; later he took up the study of tool and die steel at the Sheffield works of Thos. Firth & Sons, Ltd. In addition to his experience in the crucible and other departments at Sheffield he worked at the bench for nearly two years and obtained a thorough and practical knowledge of different types of defects, fractures and workmanship of finished high speed and tool steel bars. In 1914 he returned to the Firth-Sterling Steel Company and made both stainless steel and stainless iron. During the World War, Mr. Firth served overseas as lieutenant in the field artillery of the English army. In May, 1918, he returned to the works of the Firth-Sterling Steel Company at McKeesport, Pa., as works manager.

L. Gerald Firth

Frederick M. Nellis, special representative at New York of the Westinghouse Air Brake Company and secretary since 1899 of the Air Brake Association, died suddenly in his office on October 16. Mr. Nellis was born on February, 27, 1862, at Tionesta, Pa. At the age of 16 he learned the machinist trade at Dennison, Ohio, and after serving an apprenticeship as locomotive fireman, became a locomotive engineman on the Panhandle division of the Pennsylvania Railroad. He was throughout the remainder of his life a member of the Brotherhood of Locomotive Engineers. He entered the service of the Westinghouse Air Brake Company in 1882 as a demonstrator on its instruction car. At the age of 34, Mr. Nellis entered Cornell University, taking a special course in mechanical engineering. He graduated with the class of 1899, and then resumed his association with the Westinghouse Air Brake Company, serving in various responsible positions. About 1911 he was representative of the New England district at Boston, Mass., and since 1915 had been a special representative of the company at New York. Mr. Nellis was one of the early members and leaders of the Air Brake Association and his services contributed largely to the association's success. He became secretary of the association in 1899 and in 1924, as a compliment to his work, the association made him secretary for life. Mr. Nellis was for a number of years on the editorial staff of Locomotive Engineering and contributed many articles on air brake practice and locomotive and train operation.

F. M. Nellis

Personal Mention

General

O. A. GARBER, assistant chief mechanical officer of the Missouri Pacific, with headquarters at St. Louis, Mo., has been appointed chief mechanical officer, with the same headquarters, succeeding W. H. Fetner, deceased.

T. W. LOVE, general road foreman of engines of the Missouri Pacific, has been appointed trainmaster of the Wagoner district of the Central division, with headquarters at Van Buren, Ark., succeeding S. E. Willis, deceased.

M. W. HASSETT, whose appointment as assistant superintendent of motive power of the New York Central, with headquarters at New York, was announced in the October *Railway Mechanical Engineer*, was born on May 29, 1875, at Crittenden, N. Y. He received his education at Niagara University, and first entered railroad service on July 1, 1896, as a telegrapher with the New York Central. He entered the motive power department of the same company in December, 1899, and was promoted to master mechanic, with headquarters in Buffalo, N. Y., on December 15, 1909. In September, 1920, he was appointed general master mechanic of district number 2, with headquarters at Buffalo, N. Y.

RAY M. BROWN, whose appointment as superintendent of motive power of the New York Central was announced in the October *Railway Mechanical Engineer*, was born in Ashtabula, and on April 9, 1879. He was educated in the public schools, and first entered railroad service on October 9, 1899, as a machinist apprentice with the Lake Shore & Michigan Southern, with headquarters at Cleveland, O. He subsequenty held the position of machinist and draftsman until April, 1910, when he was promoted to the position of chief draftsman, with headquarters at Elkhart, Ind. In September, 1911, he was promoted to designer, with headquarters at Cleveland, O., and served in this capacity until March, 1912, when he was appointed assistant engineer, with the same headquarters. In September, 1915, he became assistant engineer of the New York Central, with headquarters at New York, and in May, 1924, was promoted to assistant superintendent of motive power.

J. W. DODGE, superintendent of fuel conservation of the Illinois Central, with headquarters at Chicago, who retired on August 1, was born on July 29, 1856, at Waterloo, Wis., and entered railway service in April, 1880, as a clerk in the office of the superintendent of the Illinois Central at Centralia, Ill. Three months later he was promoted to chief clerk to the superintendent and in July, 1881, was transferred to Cairo, Ill. In July, 1882, he accompanied the general manager as secretary during an inventory of the Chicago, St. Louis & New Orleans just prior to its transfer under lease to the Illinois Central, and on his return was promoted to assistant agent at Cairo and later to acting agent and commercial agent at the same point. From July, 1887, to April, 1890, he served as chief clerk to the general superintendent at Chicago, when he resigned because of his health. He then spent five years on the Pacific coast, four of them as secretary of the Chamber of Commerce of Seattle, Wash. He returned to railway service in January, 1896, as a clerk in the mechanical department at Chicago, where he remained until April, 1897, when he was transferred to Memphis, Tenn., as chief clerk to the superintendent. In July, 1901, he was transferred to Water Valley, Miss., and in July, 1905, was promoted to supervisor of trains and tracks at Durant, Miss., where he served until October, 1908. He then returned to Memphis as chief clerk to the general superintendent and later was transferred to New Orleans. From July, 1911, to May, 1912, he was division superintendent at Vicksburg, Miss., and was then promoted to inspector of transfers at Chicago. In January, 1924, he was appointed to the newly created position of superintendent of fuel conservation. From 1922 to 1925, Mr. Dodge served as the vice-president of the International Railway Fuel Association and as president of the same organization during 1925-1926.

J. W. Dodge

W. H. FLYNN, whose appointment as general superintendent of motive power of the New York Central, with headquarters in New York, was announced in the October *Railway Mechanical Engineer*, was born on June 24, 1877, at Buffalo, N. Y. He was graduated from the Michigan Agricultural College, and entered railway service in September, 1899, as a draftsman in the offices of the Cleveland, Lorain & Wheeling. From September, 1900, to March, 1902, he held the position of draftsman in the mechanical engineer's office of the Michigan Central. In March, 1902, he was promoted to assistant foreman, and, later, to general foreman of the Jackson locomotive shops, which position he held until September, 1907. From September, 1907, to June 1, 1912, he served as master mechanic at St. Thomas, Ont. On June 1, 1912, he was promoted to superintendent of motive power of the same road, and in April, 1925, was transferred to New York, as superintendent of motive power on the New York Central.

Master Mechanics and Road Foremen

M. U. WARD has been appointed road foreman of engines on the Toledo, Peoria & Western.

A. HAMBLETON, master mechanic of the Chicago, Rock Island & Pacific at Dalhart, Tex., has been transferred to Trenton, Mo., succeeding J. M. Kerwin.

G. C. JONES, division road foreman of engines of the Atlantic Coast Line at Waycross, Ga., has been appointed general road foreman of engines with headquarters at Jacksonville, Fla.

J. L. Rawlings has been appointed assistant road foreman of engines of the Virginia division of the Seaboard Air Line, with headquarters at Norlina, N. C., succeeding C. B. Ranson.

F. G. TOATES, assistant road foreman of engines of the Southern Pacific at Los Angeles, Cal., has been promoted to road foreman of engines of the San Joaquin division, with headquarters at Bakersfield, Cal.

EDWARD RICHARD DOWDY, whose appointment as master mechanic of the Chesapeake & Ohio, with headquarters at Richmond, Va., was announced in the September issue of the *Railway Mechanical Engineer*, was born on April 18, 1880, in Cumberland County, Va. After attending the Miller Manual Labor School near Crozet, Va., he served his apprenticeship with the Newport News Shipbuilding & Dry Dock Company, at Newport News, Va. He entered the employ of the C. & O. on May 12, 1902, and for thirteen years was a machinist at the Seventeenth street shops at Richmond. He then served successively as assistant foreman and foreman, and for over two years was equipment inspector at Schenectady, N. Y., and at Newport News. He was then promoted to general foreman at Newport News, later being called to the general office and assigned special

E. R. Dowdy

duties. On October 1, 1925, he became assistant master mechanic of the Fulton shops at Richmond.

J. M. Kerwin, master mechanic on the Chicago, Rock Island & Pacific, at Trenton, Mo., has been transferred to the Illinois division and placed in charge of the locomotive and car departments, with headquarters at Silvis, Ill.

J. J. Fitzgerald, acting master mechanic of the Chicago Terminal division of the Chicago, Rock Island & Pacific at Chicago, has been promoted to master mechanic in charge of the locomotive department at the same place.

C. B. Ranson, assistant road foreman of engines of the Seaboard Air Line at Norlina, N. C., has been promoted road foreman of engines, East Carolina division, with headquarters at Andrews, S. C., succeeding C. A. Goodwin, deceased.

R. D. Bulluck, division road foreman of engines of the Atlantic Coast Line at South Rocky Mount, N. C., has been appointed master mechanic of the Richmond, Norfolk and Fayetteville districts, with headquarters at Rocky Mount, N. C., succeeding J. H. Painter.

J. H. Painter, master mechanic of the Atlantic Coast Line at Rocky Mount, N. C., has been transferred to the Wilmington district, with headquarters at Wilmington, N. C. Mr. Painter has been in continuous service on the Atlantic Coast Line for 20 years. In September, 1906, he became locomotive gang foreman; in December, 1906, locomotive erecting shop foreman; in July, 1907, general foreman; in December, 1909, shop superintendent, Emerson shops, and in November, 1923, master mechanic at Rocky Mount.

Car Department

W. S. Bennett, car foreman of the St. Louis-San Francisco at Kansas City, Mo., has been transferred to Birmingham, Ala.

Guy B. Davis, shop inspector on the Union Pacific, has been promoted to general car foreman, with headquarters at Grand Island, Neb.

W. A. Hutton, car foreman of the St. Louis-San Francisco at Neodesha, Kans., has been transferred to Kansas City, Kans., succeeding W. S. Bennett.

Shop and Enginehouse

Louis V. Mallory, gang foreman of the Missouri Pacific at Kansas City, Mo., has been promoted to division foreman, Memphis division, with headquarters at Lexa, Ark.

E. J. Ball, acting superintendent of shops of the New York, New Haven & Hartford, at Van Nest, N. Y., has been appointed superintendent of shops, with the same headquarters.

A. H. Ostberg, mechanical inspector at the West Burlington shops of the Chicago, Burlington & Quincy, has been promoted to the newly created position of assistant superintendent of the Aurora shops, with headquarters at Aurora, Ill.

Purchases and Stores

C. E. Swanson, storekeeper of the Chicago, Burlington & Quincy at Plattsmouth, Neb., has been transferred to Denver, Colo.

W. O. Weber has been appointed division storekeeper of the Northern Pacific, with headquarters at Dilworth, Minn., succeeding A. C. Johnson.

C. A. Nichols, district storekeeper of the Northern Pacific at St. Paul, Minn., has been promoted to traveling storekeeper, with the same headquarters, succeeding H. M. Smith.

H. M. Smith, traveling storekeeper on the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to assistant general storekeeper, with the same headquarters.

A. C. Johnson, division storekeeper of the Northern Pacific at Dilworth, Minn., has been promoted to district storekeeper, with headquarters at St. Paul, Minn., succeeding C. A. Nichols.

E. H. Grometer, general foreman of stores on the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been appointed storekeeper at Plattsmouth, Neb., succeeding C. E. Swanson.

C. C. Kyle, general storekeeper of the Northern Pacific, with headquarters at St. Paul, Minn., who has been promoted to purchasing agent to succeed R. J. Elliott, promoted to director of purchases, entered railroad service in 1892, as a stenographer on the Northern Pacific at Brainerd, Minn. Later he was promoted to chief clerk at Brainerd and he occupied both positions until 1904, when he was transferred to St. Paul as chief clerk in the mechanical department. In 1916, he was promoted to superintendent of the general office building at St. Paul where he remained until 1921, when he was appointed acting general storekeeper, with the same headquarters. In the next year he was appointed general storekeeper.

C. C. Kyle

T. J. Hegeman, on the staff of the vice-president on the Chicago, Burlington & Quincy, has been appointed superintendent of reclamation and scrap, with headquarters at Eola, Ill.

Robert J. Elliott, purchasing agent of the Northern Pacific, at St. Paul, Minn., who has been promoted to director of purchases, with the same headquarters, was born at Louisville, Ky., and began railway work as a clerk in the accounting department of the Northern Pacific, in March, 1892. A short time later he was transferred to the staff of the general manager, and after serving the company in various capacities he was, in 1905, promoted to general storekeeper, with headquarters at St. Paul. In 1907, he was promoted to assistant purchasing agent, with the same headquarters, where he remained until 1921, when he was again promoted to purchasing agent. He held this position until the recent enlargement of the purchasing organization which he will continue to direct from the newly created position of director of purchases.

R. J. Elliott

Obituary

Ernest L. Akans, master mechanic on the Southern at Atlanta, Ga., died at his home on October 5.

P. J. Meade, master mechanic of the Atlantic Coast Line, with headquarters at Wilmington, N. C., died in that city on September 30, 1926.

C. B. Daily, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at the Forty-seventh street shops, Chicago, died on September 23.

William O. Cook, master mechanic on the Denver & Rio Grande Western, at Denver, Colo., from 1923 to 1925, died at his home in Denver on September 18.

Walter G. Tubby, who resigned as general storekeeper of the Great Northern in 1905, to become chief of the division of materials and supplies of the Isthmian Canal Commission, died on September 22 at Seattle, Wash., from heart trouble.

Railway Mechanical Engineer

Volume 100 DECEMBER, 1926 No. 12

Table of Contents

Are you interested in the orders placed by the railroads for MACHINE TOOLS AND SHOP EQUIPMENT during 1926?

See the JANUARY ISSUE

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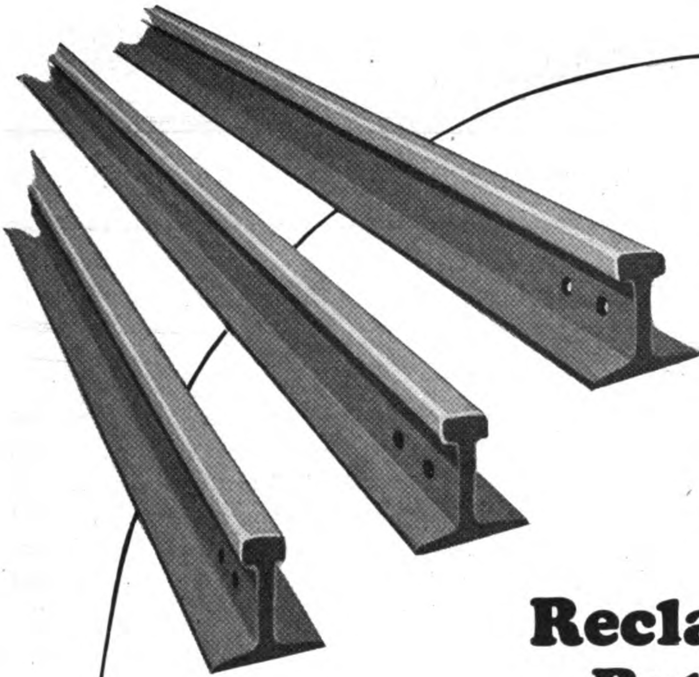

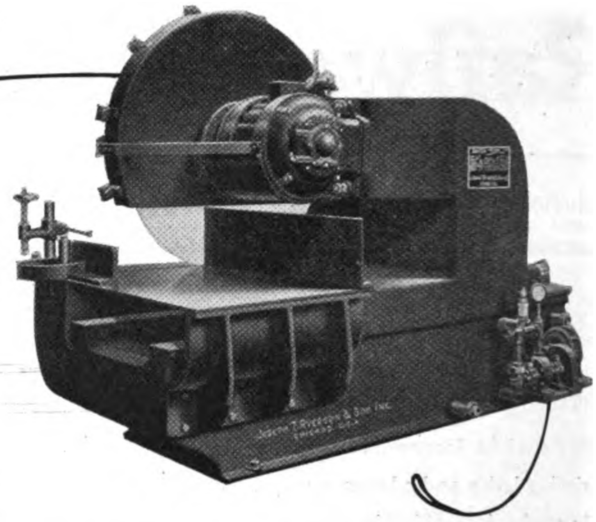

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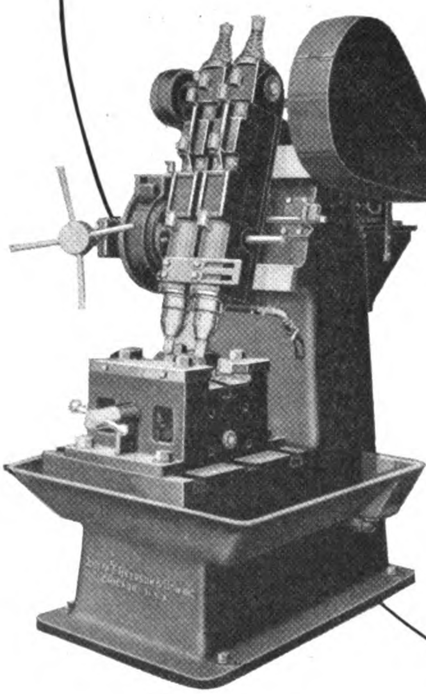

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Vol. 100 December, 1926 No. 12

Alloy steels in locomotive parts

The use of alloy steels in locomotive parts has long been under consideration and much progress has been made in their use for frames and forgings. In the case of forgings the possibilities which these alloys offer for the reduction of weight because of the higher working stresses to which theoretically at least, they can be subjected, as compared with carbon steel, have appeared very attractive and, to a limited extent, have actually been utilized. Where doubt has existed as to the possibility of designing these parts for higher working stresses, their use has effected a higher factor of safety, with resulting increases in life and reductions in maintenance cost. A new field for the application of alloy steel is now being opened up; that is, the locomotive boiler. Here a nickel alloy steel has been used for boiler sheets and staybolts, the increased strength of the alloy as compared with carbon steel offering the possibility of providing for materially increased boiler pressures without increase in weight. If the ultimate experience of the limited number of applications of this kind now under way justifies the practice, the limitation as to boiler pressure of the stayed flat sheet type of firebox construction, which is now considered to be approximately 250 lb. per sq. in., will be very materially reduced and the possibility for the rapid extension of higher boiler pressures, without awaiting the development of other types of construction, will be greatly increased.

Grinding lathe and planer tools

An eastern railroad has installed in its toolrooms machines for grinding lathe, planer and shaper tools, the purpose of which is to centralize the grinding and distribution of these tools. The system, briefly, consists of grinding all lathe and planer tools in the toolroom, from which point they are delivered to the machines by messengers who, when furnishing a new tool, take a similar worn tool back to the toolroom. This method is a decided departure from the practice still followed on many railroads of allowing the workman to grind their own tools. The new method has its advantages. An investigation revealed that many thousands of dollars' worth of tool steel was lying idle in the cupboards of the workmen. These tools were removed and placed in the toolroom and the workmen allowed cupboards only large enough to keep their personal tools locked up. As a result of this move, the railroad found that it had on hand enough tool steel to meet its needs for months to come. Every workman had his own ideas as to the correct method of grinding a tool. And as a result there is no standardization of cutting edges for tools which, in many cases, affect production and the quality of the work. The tools, when machine ground, are the most desirable form and the cutting edges are of the proper rake angle. Another reason why this practice is desirable is that it eliminates the non-production time of machines which may be valued at from one to many thousands of dollars while the operators are away grinding their tools. The tool grinder, if used by the operators, is often the common meeting ground where the men are apt to spend unnecessary time in discussions having little to do with production. This source of waste is eliminated by placing the grinder in the tool room to be operated by the tool room attendant.

The mechanical officer's job

It is safe to say that no industry provides its management with a greater diversity of difficult problems relating both to men and materials than does that of railroading. Constantly confronted with questions regarding the choice of materials or processes to give the best results in specific cases, railroad officers practically always find these questions complicated by the ever-present human factor. Doubtless, this explains why the prime requisites for success as a railroad supervisor or officer seem to be long experience, intimate knowledge of details and a judicial turn of mind, enabling all phases of a situation to be balanced, one against another and an intelligent judgment made.

The experience which one large trunk line system had in determining the best method of applying new locomotive valve motion pins and bushings well illustrates the type of problem which constantly faces railroad officers in the mechanical department. This road, in common with many others, at one time used case-hardened pins and case-hardened steel bushings. Trouble developed owing to the pins being galled, and analysis indicated that the causes were improper workmanship, improper case-hardening and lack of lubrication. The method was then tried of using brass bushings and a special grade of steel, untreated, for the pins, which avoided any probability of trouble from a non-uniform job of case-hardening and consequent seizing. It was then found that the non-case-hardened pins were distorted in application by the use of a hard hammer and, as a result, tightening of the nut drew the jaws together causing heating, sticking and seizing of the pin. The lesser of the two evils was therefore chosen and the practice recommended of case-hardening the pins and using hard brass bushings.

Regarding this situation the mechanical engineer of the road said: "Some years ago nothing was ever considered but case-hardened pins and bushings for motion work but the work of fitting them up was considered the most particular and accurate work on the locomotive. All pins were polished after being case-hardened, and all bushings were lapped out with lead mandrels on a drill press, using oil and fine emery. Also, enginemen took

better care of lubricating their locomotives and as a result no trouble of any sort was experienced with motion work pins."

It will be observed from this example that railroad shop practice and, in fact, practically all phases of railroad operation are a compromise of ideal conditions to meet practical considerations. Is it any wonder that experience of long years and judgment of the highest type is required in mechanical department officers and supervisors for the best results?

Greater safety in passenger train operation

The practice that the Pennsylvania has adopted of operating its passenger trains without the use of the angle cock, which will ultimately be eliminated from the brake equipment, is a valuable contribution to advancement in the railroad industry. The idea, however, is not a new one, for the possibility of operating trains satisfactorily without the angle cock as a part of the air brake equipment has been discussed by air brake men at various times during the past 20 years. The tests on which the decision to eliminate the angle cock by permanently clamping the handle in the open position is based, are described elsewhere in this issue. A dummy coupling is used to blank the brake pipe at the end of the train or cut of cars. This permits all switching of cars to be controlled by the air brake. Of course, when switching cars without the use of angle cocks, it is necessary to deplete the brake pipe pressure before any separation is made. Depleting the brake pipe pressure to uncouple the hose makes this operation considerably safer for the trainmen. The Pennsylvania finds that it requires 18 seconds to deplete the brake pipe pressure with the brake valve handle in emergency position in a seven car train equipped with UC valves and 15 seconds to restore the pressure with the brake valve handle placed in full release position. Thus the time required for these two operations is comparatively short, but on the other hand, time is a very important factor at a busy terminal. Of course, the principal reason for eliminating the angle cock is that of obtaining greater safety in passenger train operation. Several serious wrecks have been traced to a closed angle cock somewhere in the train, which deprived the engineman of his full braking power.

Angle cocks have always been a source of trouble, especially in developing leaks at the key. The Air Brake Association Committee on Brake Pipe Leakage placed angle cock keys at the head of the list of worst offenders in its report at the 1926 annual convention. If trains can be operated successfully without having angle cocks included in the air brake equipment, their eventual elimination is fully warranted.

An economic problem in car repairs

The question of manufacturing in railroad shops, to which considerable attention has been given during recent years by various industries supplying material to the railroads, has again been brought to attention by a letter from the American Railway Car Institute to R. H. Aishton, president of the American Railway Association, dealing with the effect on the car building industry of the present tendency of the railroads toward the expansion of manufacturing facilities for the rebuilding of old cars or the building of new cars. This letter (signed by the president of the Institute, J. M. Hansen, chairman of the board of the Standard Steel Car Company, and by two vice-presidents, W. H. Woodin, president, American Car & Foundry Company, and J. F. MacEnulty, vice-president, Pressed Steel Car Company) sets forth somewhat the same reasons as to the unsoundness of this policy, the continuation of which is said to threaten the future existence of the contract car builders, as those set forth in the summer of 1925 by a group of seventeen members of the freight car repair industry in a communication addressed to the Interstate Commerce Commission. These reasons may be divided roughly into two groups: those which deal directly with the immediate welfare of the railroads and those which deal with the broad responsibility of the railroads to the car building industry in particular and for the welfare of the country as a whole. Briefly summarized, the reasons why the continued expansion of manufacturing facilities by the railroads are considered as against the interests of the railroads themselves are as follows: It complicates the problems of organization and management; the qualifications for leadership in railroad organizations have to do with the conduct of transportation and not with manufacture; it involves the assumption of responsibility for a growing number of employees who cannot be employed steadily; peaks and depressions can be more effectively handled in contract shops because contractors are more free from regulatory restrictions; it deprives railroad managers of freedom of action by producing a more irresponsible control of labor; it removes the building of railroad equipment from a competitive field to a non-competitive field, where the incentive for low costs is too remote to be effective; and the costs to the roads of manufacturing and rebuilding equipment in their own shops are normally higher than in well organized contract shops. In connection with the last reason, the letter points out that the car builders are deterred from charging more than a living profit because of the competition in the industry, the effect of which for the past five years has been a net profit below a fair return on the investment in the industry, and that the low overhead commonly figured by the railroads as compared with that of the contract builders, representing as it does a much less efficient development in plant and equipment, would cause failure from inefficiency if the railroads were compelled to make their living from the returns on their manufacturing operations.

The arguments which may be grouped in a second classification are that the car building plants have been built up in response to the railroads' need for equipment and that so long as they remain prepared to serve, the roads are in a measure responsible to them; that the car building plants have rendered invaluable service to the roads and to the nation in important emergencies, notably during the European war when they supplied not only cars, but much military equipment for use abroad; that the highly trained organization of car builders has been responsible for much of the progress made in the design of equipment and in the development of methods for its economic manufacture; that the car manufacturers sustain many other industries, the welfare of which is a matter of importance to the roads and to the country; that it is doubtful whether the roads, being primarily transportation agencies, are more justified in engaging in general manufacturing operations than they are in engaging in the operation of coal, oil and other properties, and that if the roads persist in developing their own manufacturing facilities, much of the half billion dollar investment in contract car plants will be destroyed—an economic waste not justified.

The problem presented is not an easy one to solve. To the car building industry it appears as one of broad

policy which should be considered as a whole. To the railroads it appears as a vast group of individual cases, each one of which is to be settled separately after balancing all of the factors applying in that specific case. The car builders' argument for themselves is really all summed up in the statement that the cost to the roads of manufacturing and rebuilding equipment in their own shops is higher than of having it done in well-organized contract shops. The argument against the railroad is really all summed up in the one statement that the serious impairment or destruction of the investment in the car building industry is economic waste.

This is a matter in the settlement of which mechanical department officers have a large responsibility. The solution of the problem hinges on the question of overhead and it is doubtful whether many mechanical department officers have given this question the serious consideration which it justifies. The neglect to include many items of overhead in the cost of certain manufacturing operations conducted by the railroads is frequently justified on the grounds that they are by-product operations. Such operations cease to be by-products, however, when they require investment in additional plant and facilities not already available. How far this phase of the problem has been overlooked is a matter of fact which can only be determined by a broad investigation. The suggestion that the railroads and the car builders develop a joint board or committee to conduct such an investigation probably offers the best means of establishing the facts. With a comprehensive basis of accepted facts once established, a long step will have been made toward an economically sound solution of the problem.

Are you throwing good money away?

It seems to be a trait of human nature to mount a hobby and then proceed to ride it to death. The contriving and building of devices operated by compressed air, is a hobby that a great many mechanical department foremen persist in riding to the limit. Undoubtedly, the car department is more guilty of this offence, and with more excuse, than the locomotive department. Yet, the latter is not entirely innocent. A surprisingly large number of home-made air-operated tools and facilities, such as hoists, presses, formers and the like, can be found in practically any car repair shop. The most surprising part of this situation is that a large proportion of the jobs done on many of these devices can be done more economically and faster on any one of many manufactured facilities that have been especially designed and thoroughly developed for just such work.

A number of instances can be cited where additional air compressors have been installed in shop power plants to meet the additional load which has been created largely by the increased use of inefficient shop-made, air-operated equipment. An air compressor having an output of 2,000 cu. ft. per min. costs approximately from $16,000 to $20,000. Furthermore, it costs something to operate such a compressor. For example, if it requires 22 b.hp. to deliver 100 cu. ft. of free air per minute at 90-lb. pressure and the engine which operates the compressor requires 30 lb. of steam per horsepower hour, and the boiler evaporates 7 lb. of water per pound of coal, with coal at three dollars a ton, the coal cost per 100 cu. ft. of free air is 0.22 cents. One large car shop uses a home-made air operated press for straightening the sheets for steel cars. The piston for this press operates in a cylinder 30 in. in diameter by 18 in. long. The piston serves as a ram, to the lower end of which is secured a cast iron block, 7 in. by 15 in. by 12 in., which weighs approximately 325 lb. This is operated almost continuously and makes an average of one stroke per minute. At that rate, the press consumes 7.38 cu. ft. of compressed air, or 52.5 cu. ft. of free air per min. at 90 lb. gage, and with the compressor operating at a ratio of 7.12. Using the figure of 0.22 per 100 cu. ft., this press will consume 25,200 cu. ft. of free air per day at a cost of $5.55 for coal alone.

This, keep in mind, does not include maintenance of pipe, hose lines, etc., nor does it make any allowance for leakage. With a pressure of 90 lb. gage, a hole only 1/16 in. in diameter will allow the escape of 380 cu. ft. of free air per hour. A single hole of that size will waste $14.70 worth of coal during a month of 22 working days. It does not require many deficiencies in the equipment, such as having the cylinder too large for the job, a leaky piston the wrong size of piping, etc., to multiply the theoretical cost of operation many times.

Of course, all shop-made air-operated devices are not inefficient, but it would be interesting to know just how many are and how many are not. Such information should be of value to the shop superintendent who is striving for economy in the operation of his shops. The time spent in checking the air consumption of these devices is time well spent. Such information will be of considerably more value if compared with the cost of operating a machine that has been especially designed and constructed for the job. Calculating the air consumption of an air-operated device before it is built, will also, in many instances, result in economy. Some mechanical departments have placed the design and construction of such equipment under the supervision of the mechanical engineer and considerable improvement has been accomplished by this system, not only in the selection of the most efficient of those proposed, but also in the adoption of the best device as standard for all shops on the system. Furthermore, placing the development of shop-made, air-operated devices in the hands of a general supervisor tends to regulate their production and prevents many shop foremen from over-riding an expensive hobby. The air we breathe is free, but don't forget that it costs money to compress it.

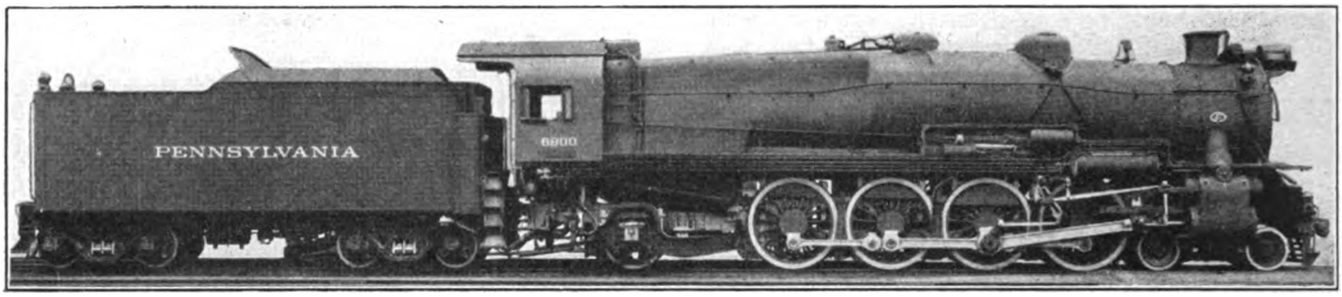
New Books

ARC WELDING, THE NEW AGE IN IRON AND STEEL. 160 *pages illustrated.* 6 *in. by* 9 *in. Price* $1.50. *Published by the Lincoln Electric Company, Cleveland, Ohio.*

This book is devoted largely to the use of arc welding in general production manufacturing. It stresses the fact that arc welding has developed beyond that of a repairing or salvaging process and that the arc welder is a production tool. It also contends that a knowledge of arc welding principles should be a part of the equipment of every designer and manufacturer working in iron and steel. The book contains more than 200 illustrations, chiefly of products of representative manufacturers which have been manufactured by arc welding. In addition there are numerous diagrams and charts showing welding speeds and costs.

It points out that there are two main fields for production welding. The first and perhaps the best known is the use of arc welding in place of riveting.

The second main field for arc welding is the substitution of arc welded steel for cast iron. This book makes the claim that 90 per cent of the iron castings now used could be replaced by arc welded steel at a decided saving. There is a complete discussion of how to go about redesigning cast iron for manufacture in steel and the illustrations show clearly where this is being done commercially by representative manufacturers.



Mountain type locomotive, Class M1, for the Pennsylvania

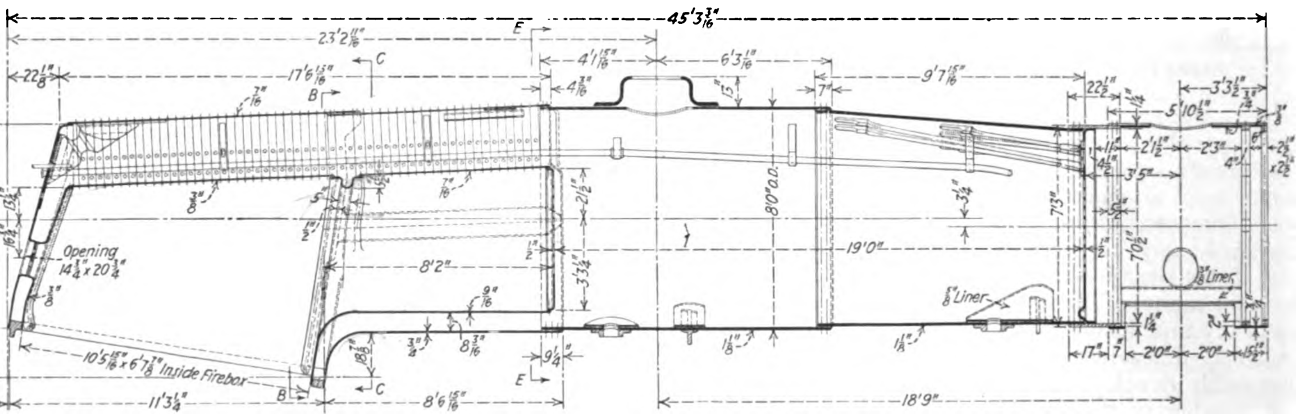
Pennsylvania buys 200 Mountain type locomotives

Several features in design of the boiler and frame—72-in. drivers—Tractive force 64,550 lb.

The Pennsylvania built at its Juniata shops, Altoona, Pa., in 1923, a 4-8-2 type locomotive which was notable because of its high capacity and unusual construction. In accordance with the Pennsylvania's policy, this locomotive was subjected to a series of exacting tests both on the road and at the Altoona test plant, before any additional units of the same class were ordered. After the locomotive had proved itself fitted for the service requirements, orders were placed with the Baldwin Locomotive Works for 175 and with the Lima Locomotive Works for 25 additional locomotives of the same type. These locomotives are designated by the railroad company as Class M 1, and are now being placed in service. They were designed by the motive power department of the Pennsylvania under the supervision of J. T. Wallis, chief of motive power. They are intended for heavy passenger service, for which reason the driving wheels are 72 in. in diameter, but will also be used for fast freight service.

The Class M 1 locomotive develops a tractive force of 64,550 lb. The cylinders have a diameter of 27 in. and a stroke of 30 in. The boiler has a working pressure of 250 lb. per sq. in. With 266,500 lb. on driving wheels, the factor of adhesion is 4.13. This high starting power in combination with a boiler of generous steaming capacity, enables these locomotives to develop large horsepower for sustained periods.

In accordance with the Pennsylvania's practice, the boiler of the Class M 1 is of the Belpaire type with tubes of moderate length—19 ft. between the tube sheets. Exclusive of the smokebox, the cylindrical section of the boiler consists of two rings, the first of which is sloped, increasing the outside shell diameter from 84½ in. to 96 in. The dome is placed on the second ring. It is of pressed steel and measures 31 in. in diameter and 13 in. in height. The longitudinal seam on this ring is placed on the right-hand side and after the sheet has been rolled to a circular shape it is flanged on top to form the hip joint connection for the Belpaire firebox.

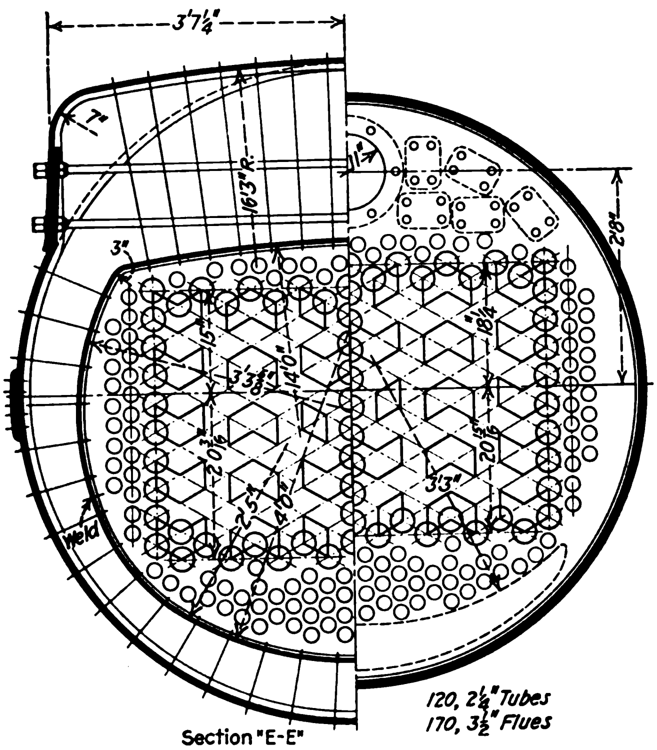


Elevation drawing of the boiler

The combustion chamber in the boiler is 8 ft. 2 in. long and this necessitates the use of a wrapper or outside shell section of corresponding length, having the Belpaire shape and staying. This combustion chamber section of the outside shell is made up of four pieces, namely, a bottom half, which is in one piece with the outside throat sheet; two side pieces and a top piece. The radius of the throat is unusually large being 16 in. at the center, reducing to a small radius at the sides. The outside firebox shell is of three-piece construction, the top and sides being separate.

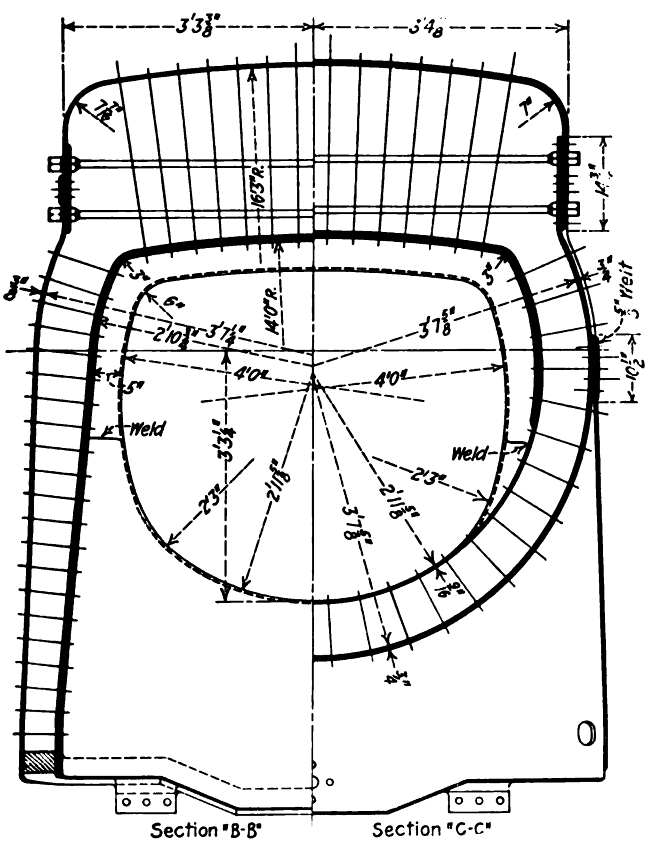
The crown and sides of the firebox are in one piece and the inside throat sheet is in one piece with the lower half of the combustion chamber. The sides and crown

of the combustion chamber constitute a separate sheet, which is butt-welded to the lower sheet on each side. The firebox and combustion chamber are united above the welded longitudinal seam by a corrugated plate



Half sections of the boiler through the combustion chamber and first course

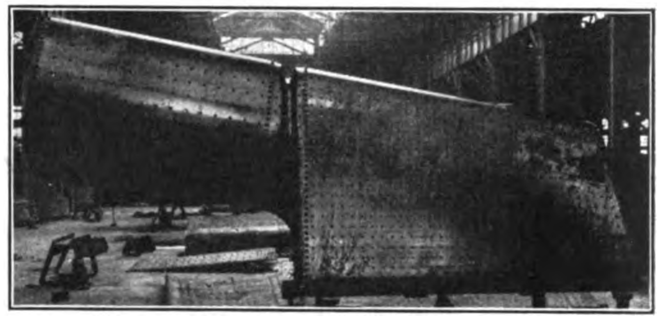
which constitutes an expansion joint. This plate has riveted seams, except on the short longitudinal side seams which are welded. The corrugation is made with



Half sections through the firebox and combustion chamber

a 2-in. radius and forms a trough about 5 in. deep across the crown sheet. This trough can be cleaned through two wash-out holes, one of which is placed on each side.

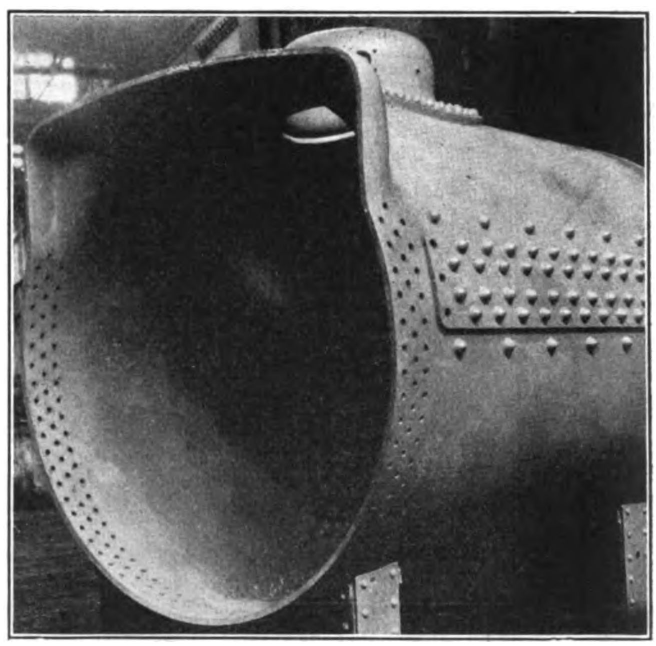
The flanging of this corrugated sheet is done on a hydraulic press and is an interesting process. As the transverse width of the sheet, after flanging is greater at mid-height than at either the top or bottom, the sides of the die are hinged so that they can be collapsed after flanging and the plate thus lifted out. The flanging of



Firebox and combustion chamber complete, showing the corrugated connection

the throat sheets also requires special treatment, due to the large size of the plates and the fact that the radius at the center is considerably greater than at the sides.

The corrugated joint described in the preceding paragraph compensates for expansion and contraction in the upper part of the firebox. To make similar provision for the lower part of the firebox, a crescent shaped corrugation is formed in the front tube sheet below the tubes. This corrugation has a maxmium depth at the center of 2 in. The combined length of the firebox and combustion chamber is so great in this design that an

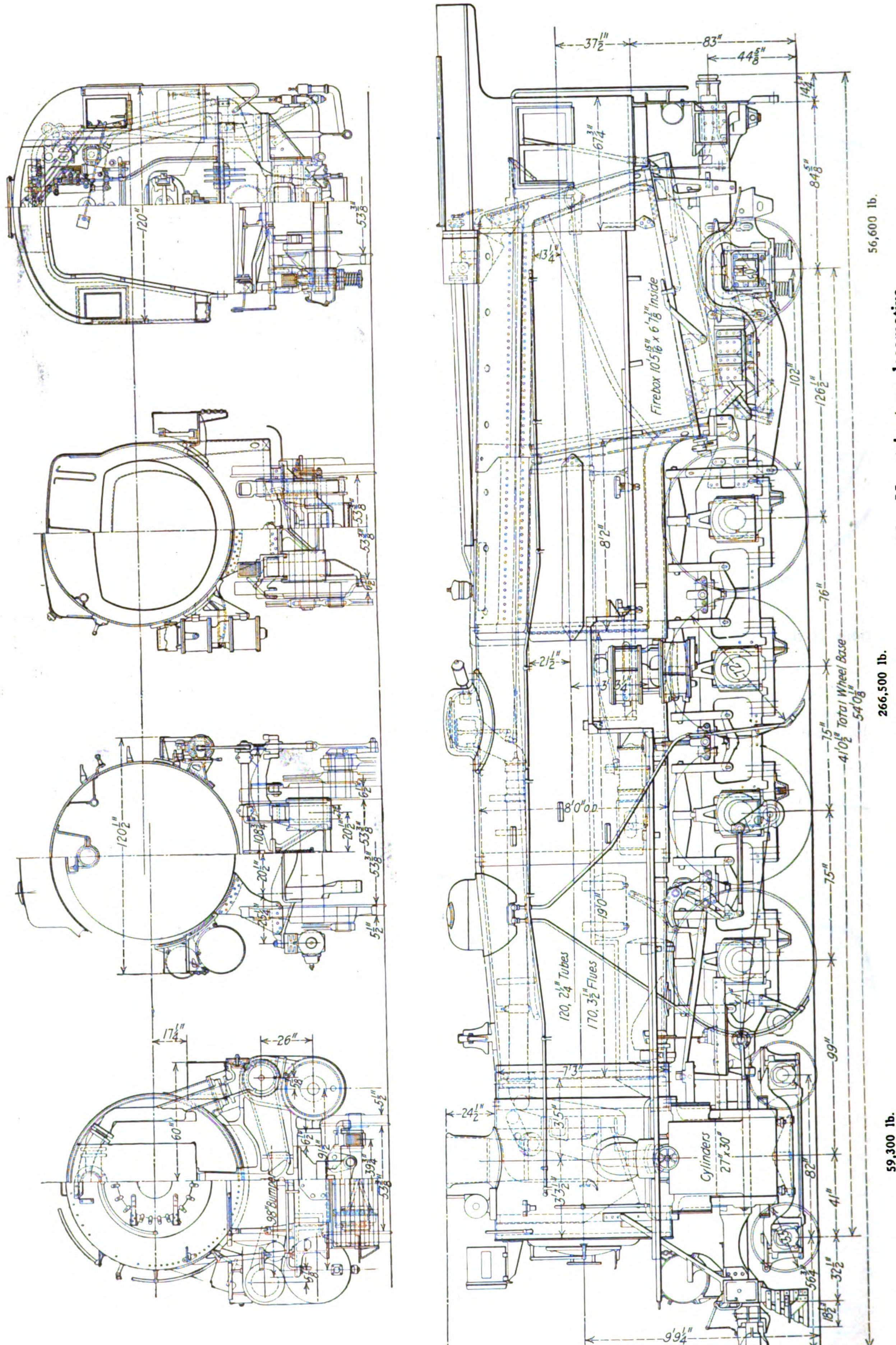


Second boiler course flanged for Belpaire connection

arrangement such as has been described is desirable in order to prevent distortion and tube leakage.

The firebox tube sheet and back sheet are riveted in place, but the joint around the door sheet is electrically welded. The flues are welded into the back tube sheet.

These locomotives are fired by mechanical stokers, the Duplex and the duPont Simplex each being used on 100

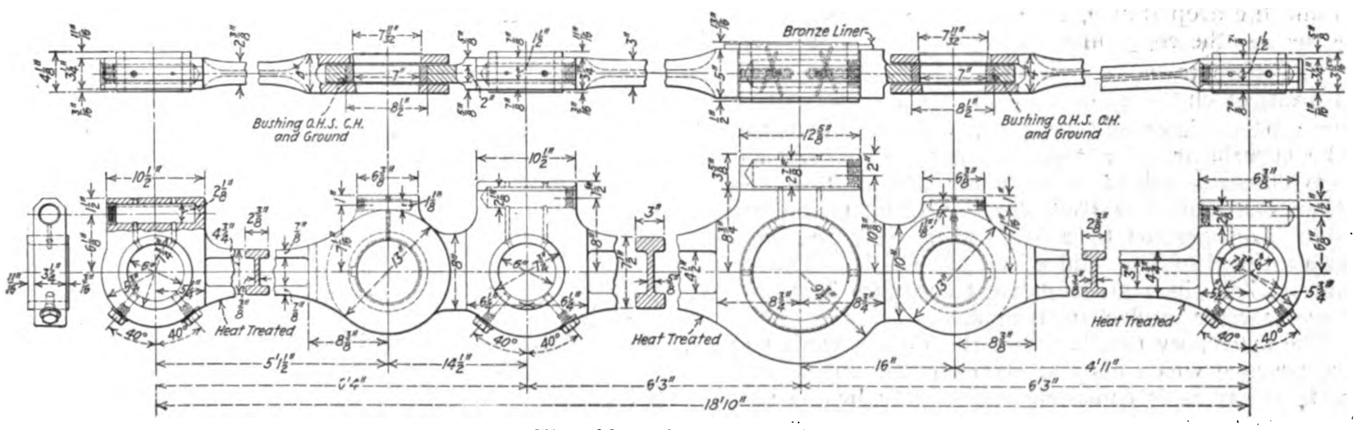


Elevation and cross section drawings of the Pennsylvania, Class M1, Mountain type locomotive

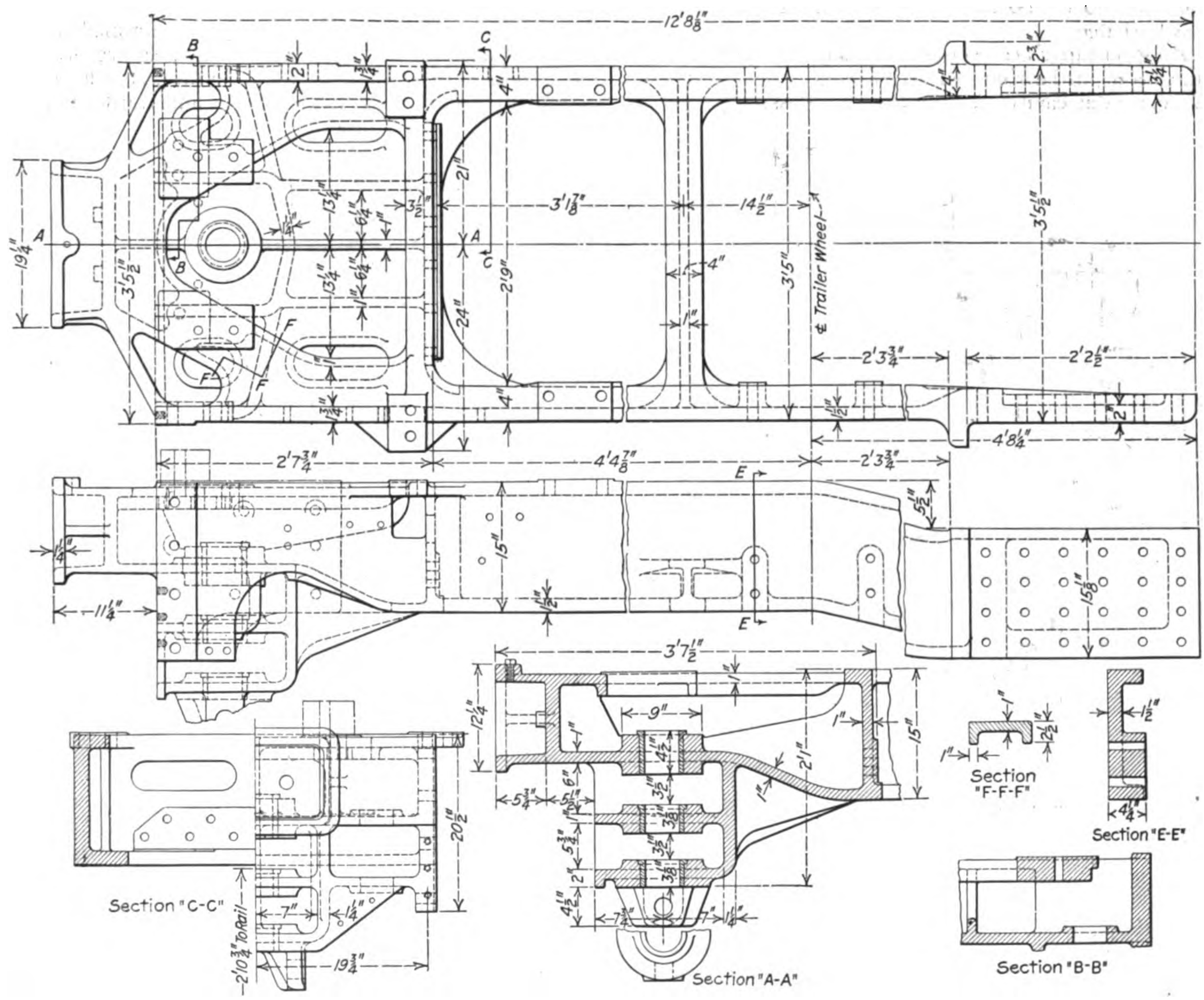
of these locomotives. The grates are arranged to shake by hand and have transverse drop plates near the front end of the firebox. The ash pan has two deep hoppers which are fitted with drop bottoms. These are controlled by levers placed on the left side, under the front end of the firebox.

The two injectors are non-lifting and they feed through checks placed on the back boiler-head. The feed water is conveyed to the front end of the barrel through internal pipes, this arrangement being in accordance with the regular practice of the Pennsylvania. The steam turret is placed outside the cab and receives its steam supply from the highest point in the boiler through an external pipe which connects to the shell near the front end of the combustion chamber roof sheet. The two safety valves are tapped directly into the shell just forward of the steam turret connection.

In addition to the usual gage cocks which are tapped into a water column on the back head of the boiler, there is a second set having pipe connections which terminate



The side rod arrangement



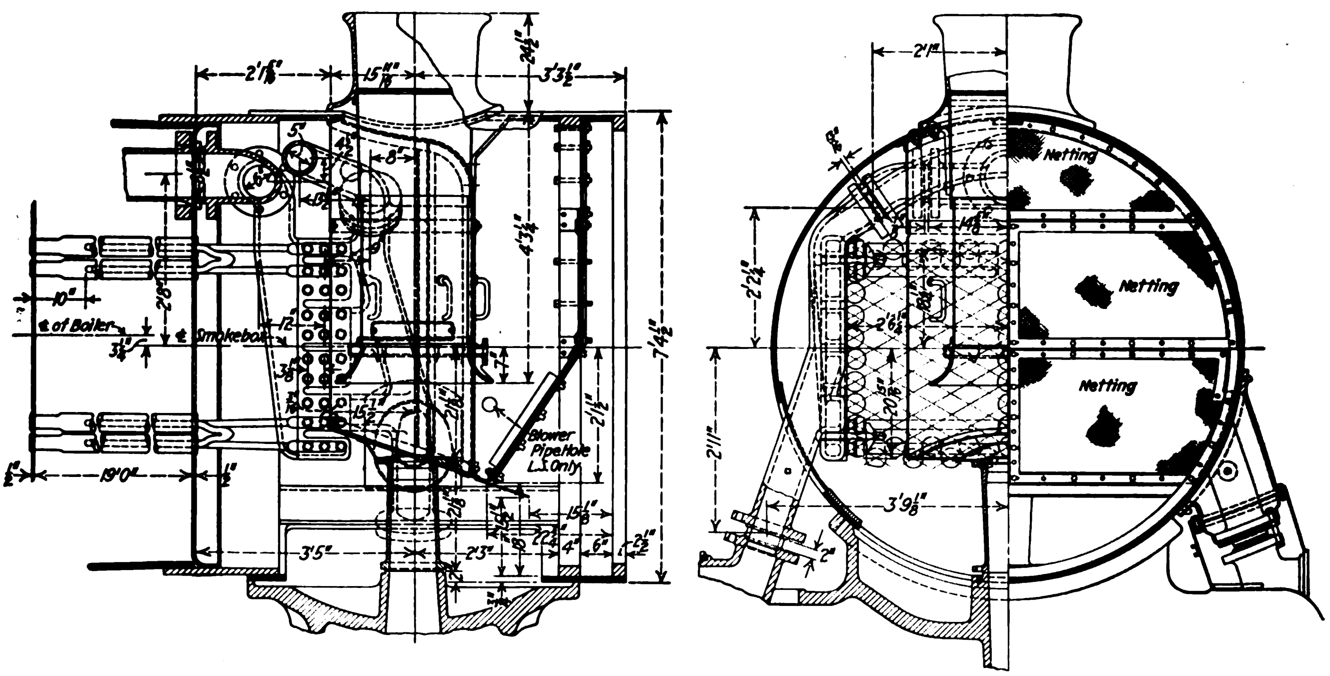
The rear frame construction

over the highest part of the crown sheet. These pipe connections are run through an external pipe which is filled with steam so that condensation is avoided. These gage cocks are placed over the boiler head in the cab. They have extension handles, conveniently located and drain into the drop funnel, so that the discharge can be easily seen by the engineman.

The dome contains a throttle valve with a balancing piston from which steam passes to the superheater header through an internal dry pipe, 8½ in. in diameter. The superheater is a type E composed of 170 single loop elements placed in as many 3½-in. flues. The steam distribution is controlled by 12-in. piston valves which are operated by a Walschaert gear and are set with a travel of 7 in. and a lead of 9/32 in. The steam lap is 1 7/16 in. and the exhaust clearance 7/16 in. A power reverse mechanism is applied.

The machinery details follow the Pennsylvania standard practice which aims at reducing the weight of the parts as far as is consistent with safety by the use of heat treatment and careful designing. The crossheads are of the underhung type, working in box shaped guides which have two inwardly projecting longitudinal ribs on each side in order to provide liberal bearing area. Each guide is made in two pieces, which join on the longitudinal center line and are held together by horizontal bolts. The crosshead bodies are of high test Vanadium steel; while the crosshead pins, piston rods, crank pins and driving axles are of heat treated carbon steel and are hollow bored. The main and side rods are also heat treated.

Floating bushings are used on the main rod back ends and the main pin bearings on the side rods. Each stub has a horizontal cavity closed by a compression grease

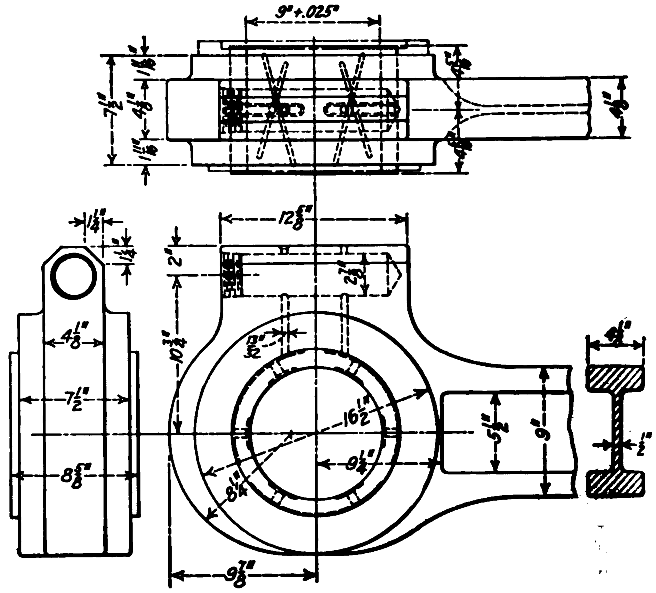


Drawing showing the smokebox arrangement

plug and communicating with holes drilled through the brass so that the pin can be lubricated.

The main frames are unusually massive as the width throughout the greater part of their length is 7 in. This is increased above the pedestals to 9½ in. by inwardly projecting lugs. Each frame is cast in one piece with a single front rail having a cylinder fit 6½ in. wide and 12 in. deep. The pedestal caps are of ample section and are held in place by three bolts on each end. Back of the rear driving pedestals the frames assume the form of slabs and are bolted to a Commonwealth cradle casting. The pedestal taper is 1½ in. by 18½ in.

The frames are braced transversely, midway between adjacent driving axles, by steel castings which are bolted



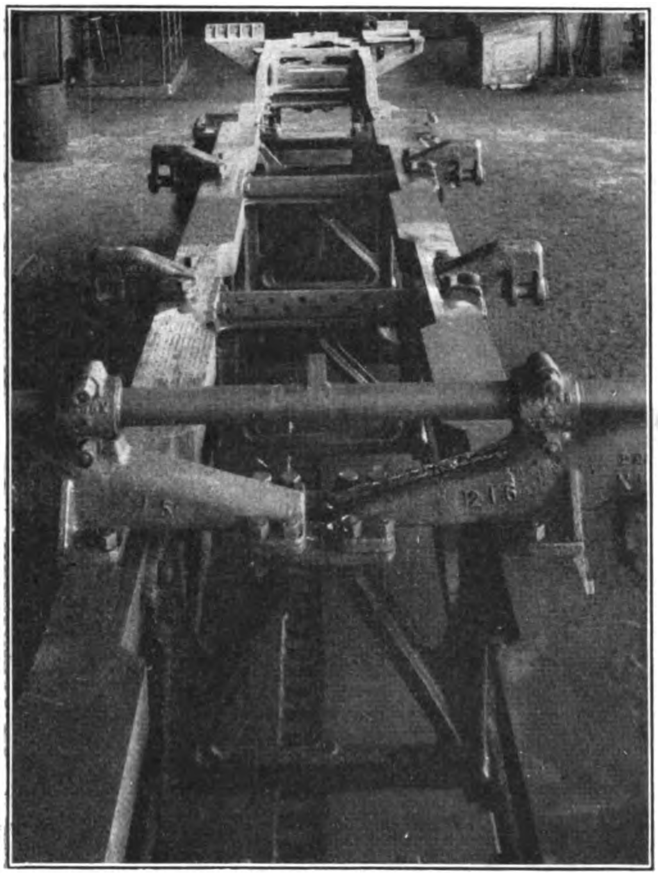
Design of main rod back end

to both the upper and lower frame rails. Intermediate boiler supports in the form of expansion plates are provided at the guide yoke which is just ahead of the leading drivers and also between the second and third pairs of drivers. The front end of the firebox is carried on slidings bearings and the rear end on an expansion plate.

The front truck is of the swing bolster pattern with three-point suspension links, while the rear truck is similar to that used on the Atlantic, Pacific and Mikado type locomotives of the Pennsylvania and formerly known as the KW type. In this design the truck frame itself acts as the rear equalizer and the main locomotive frames are supported directly on it.

In accordance with the railroad company's practice, the driving and rear truck springs are made with a reverse camber when loaded, and flanged tires are used on the front and rear driving wheels only.

Among the interesting details used on these locomotives may be mentioned the bell ringer which is air operated. When the device is in use the bell itself remains stationary, while the clapper moves. The bell can also be run by hand in the usual way if necessary. The cylinder cocks are steam operated and are controlled from the cab. When the operating valve is open the cocks are closed by steam pressure acting on the plungers. When the steam pressure is released, the plungers are moved upward by spring pressure and the cocks open. This provides a ready means of keeping the cylinders drained while the locomotive is standing.



The assembled frames and cross ties

The cylinder cocks will also open in case the pressure in the cylinders exceeds the boiler pressure due to water being tapped in the cylinders.

The tender has a one-piece frame of cast steel and is carried on two four-wheel trucks having cast steel side frames. The fuel and water capacities are respectively 35,000 lb. and 11,000 gal. and an air operated water scoop is applied.

Table of dimensions, weights and proportions for the Pennsylvania Class M1 locomotives

Railroad	Pennsylvania
Builders	Baldwin 175
	Lima 25
Type of locomotive	4-8-2
Service	Heavy passenger and fast freight
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	7 in.
Outside lap	1 7/16 in.
Exhaust clearance	7/16 in.
Lead in full gear	9/32 in.
Weights in working order:	
On drivers	266,500 lb.
On front truck	59,300 lb.
On trailing truck	56,600 lb.
Total engine	382,400 lb.
Total tender	217,900 lb.
Total engine and tender	600,300 lb.
Wheel bases:	
Driving	18 ft. 10 in.
Rigid	18 ft. 10 in.
Total engine	41 ft. ½ in.
Total engine and tender	79 ft. 3⅞ in.
Wheels, diameter outside tires:	
Driving	72 in.
Front truck	33 in.
Trailing truck	50 in.
Journals, diameter and length:	
Main	12 in. by 16 in.
Others	11 in. by 16 in.
Front truck	6½ in. by 12 in.
Trailing truck	6½ in. by 12 in.
Boiler:	
Type	Belpaire
Steam pressure	250 lb.
Fuel	Bituminous
Diameter, minimum inside	82¼ in.
Combustion chamber, length	98 in.
Tubes, number and diameter	120—2¼ in.
Flues, number and diameter	170—3½ in.
Length over tube sheets	19 ft. 1 in.
Grate area	69.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	370 sq. ft.
Arch tubes	29 sq. ft.
Tubes and flues	4,303 sq. ft.
Total evaporative	4,702 sq. ft.
Superheating	1,630 sq. ft.
Comb. evap. and superheating	6,332 sq. ft.
Tender:	
Water capacity	11,000 gal.
Fuel capacity	35,000 lb.
Wheels, diameter	36 in.
Journals, diameter and length	6½ in. by 12 in.
General data, estimated:	
Rated tractive force	64,550 lb.
Cylinder horsepower (Cole)	3,280
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	69.7
Weight on drivers ÷ tractive force	4.13
Total weight engine ÷ cylinder hp.	116.7
Total weight engine ÷ total heating surface	60.5
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp.	1.93
Tractive force ÷ comb. heat. surface	10.25
Tractive force × diam. drivers ÷ comb. heat. surface	735
Cylinder hp. ÷ grate area	46.9
Firebox heating surface, per cent of evap. heat. surface	8.14
Comb. heat. surface ÷ grate area	90.6

Boiled vs. cold saponified greases

By V. I. Downey

Chief chemist, Railway lubrication research department, The National Refining Company

WITH the possible exception of trailer boxes, the lubrication of driving journal and rod pins has been the thorn in the side of every oil company engaged in the lubrication of rolling stock. In the past few years, the arguments as to the merits of the products put out by various companies engaged in furnishing lubricants to railroads have been legion. The sad part of the matter has been that the greater part of the information regarding these products has come from salesmen and service engineers who know nothing regarding the ingredients used in the greases or the process of manufacture.

Up to the first of last year 99 per cent of the locomotive greases were made by the cold saponification method. That is, tallow or a mixture of tallow and stearic acid

were mixed in a kettle with the predetermined amount of cylinder stock. The temperature was adjusted from 90 to 110 deg. F. and a solution of caustic soda run in as rapidly as possible. The whole mass was paddled thoroughly until the first signs of "setting" were observed. The contents of the kettle were then run into barrels. The completion of the reaction between the caustic soda and the tallow took place in the barrel, and after about eight hours the grease was solid. The reaction proceeded for several days longer as evidenced by the heat given off by the grease. Analysis of hundreds of samples from various sources showed that the most satisfactory greases were made over the following approximate formula:

Tallow	44 per cent
Oil	40 per cent
Caustic Soda	7.5 per cent
Water	8.5 per cent

The fact that every grease showed a considerable quantity of free caustic indicated that the saponification was not complete. To secure a more uniform completeness of saponification various companies adopted the practice of aging their greases. That is, a batch of grease had to stand about three months before it could be shipped. The many variables in the manufacture of this type of grease were such as to make a uniform product an impossibility even though aging was resorted to. The temperature of mixing and drawing, acidity of tallow, strength of caustic solution, temperature of storage after drawing and the body of oils used were an insurmountable handicap to the greasemaker in producing grease of uniform quality.

The psychological effect of some of the "educational" work in the railway lubrication game has not helped to make the path of the service man more smooth. In some cases railway engineers have been induced to use two grades of grease, pin grease and cellar grease. Pin grease was a different color from cellar grease and sold for less money, although the only difference was that the cellar grease was darkened by the addition of a small amount of lamp black. The effect of the old custom of two grades of grease is gradually being overcome and many roads are using one kind of grease for both jobs. Some of the oil companies make the light colored pin grease by using a filtered stock in its manufacture, while a dark stock is used in the cellar grease. At least two companies are still putting out the same grease for cellars and pins except that the cellar grease is dyed a dark green. It is to be hoped that one grease can be used for both services or that the various oil companies will make a softer grease for the pins and not sell artificially colored greases of the same composition at a number of different prices.

Hot bearing due to excessive moisture in grease

The failure of so many locomotives in hot weather due to the grease leaving the cellars is inherent in a grease containing any appreciable amount of moisture. A grease can best be visualized as an emulsion. The overheating of the journal causes the moisture to vaporize and boil out. This breaks the emulsion and the oil runs out of the sodium stearate binder leaving a hard cake next to the perforated plate. This cake prevents feeding through to the journal. This hard soap formation is called "carboning" by the average engineman, but as a usual thing no carbon is found. This can readily be proved by dissolving some of the crust in water. A soapy solution is the result.

A very good indication of the performance of a grease when subjected to sudden heating of a journal can be shown by the following test: Draw out a ¼-in. glass tube to a fine point, stick the larger end of the tube into the cake of grease and shove a plug of grease about ⅜ in. long down in the tube to where the capillary begins. Tie the tube to the bulk of a thermometer and place in a large test tube. Place the test tube in an oil bath and heat slowly to around 200 deg. F. If the grease is of the cold saponified type the oil will run down and leave a residue which is the soap. The moisture shows up by being released in puffs which break the cake up into fragments and release the oil more rapidly. This phenomenon takes place in the cellar, as shown by the fact that the residue is usually granular or honeycombed.

Boiled grease

The fact that the above type of grease was unsuitable was recognized by the leading companies and early in 1925, after considerable research, three companies put boiled greases on the market. These greases are made by carrying out the saponification under heat and cookign out the moisture until the finished product contains a small fraction of a per cent of water.

With the old type grease it is necessary to have an excess of caustic soda present in order for the reaction to proceed to the extent it does. This excess caustic soda is a source of irritation to the men handling the grease.

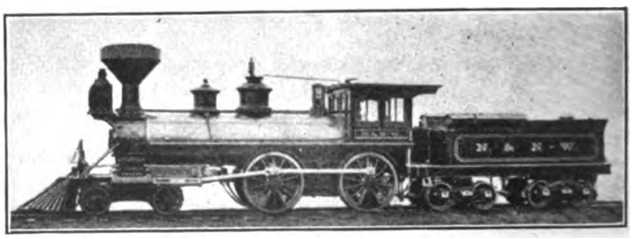
It is possible with a cooked grease to calculate the required amount of caustic necessary to make a neutral grease which will not attack the workman's skin. By carrying the saponification to completion under heat the greasemaker can be sure of getting uniform batches if he uses the same amounts of ingredients each time and the ingredients are kept of the same quality by the purchase of material to specification.

Previous to the advent of the boiled product, a grease was either too soft, too hard or satisfactory, according to the distance which the engineman was able to push his thumb into the cake. With the boiled grease a great deal more oil can be incorporated in the grease with a consequent increase of its lubricating power.

Service tests of boiled greases against cold saponified greases show a greatly increased mileage per pound of grease. This increase in mileage has been shown to be as great as tenfold in many cases.

In the case of slow moving power, switch engines and coal trains, a slight change has been found necessary in the perforated plates. The perforations have to be made larger to insure feeding of the grease since the journal speed is slow and consequently the grease is not heated rapidly enough to cause it to flow through the smaller perforations.

With the advent of so many companies with well equipped laboratories into the railway lubrication field, many radical changes can be expected for the improvement and betterment of locomotive lubrication in the near future.



Northern & North Western locomotive No. 65, built by Brooks in 1881—17-in. by 24-in. cylinders; diameter of drivers, 61½ in.

"The Secret of High Wages"*

The fourth of a series of discussions of books on improved supervision and better employee relations

THE United States is unique among the nations of the world in the high wages paid to its industrial workers and the low prices of manufactured products. As a result workers in this country enjoy a relatively much higher standard of living than anywhere else in the world. Why is this so? Is it solely or even largely because of our great natural resources or are there other important factors involved? These questions are being asked by workers, industrial leaders, statesmen, etc., throughout the world and especially in Europe.

Great Britain in particular has been interested in learning the secret of our success. Two young engineers, Messrs. Austin and Lloyd, visited this country during the latter part of 1925. Their impressions were printed for private circulation; they caused so much comment in the English and Continental press, however, that it was decided to publish a book, "The Secret of High Wages," which is the subject of this review.

It is significant that the Prime Minister of England in an address early this year made the following statement: "I venture to think that no trade union leader could do better service to the cause he represents than by investigating closely what the methods are that enable the American workmen to enjoy a better standard of living than any other working people in the world, to produce more, and at the same time to have so much higher wages." Since that time The Daily Mail of London has sent to this country a mission of eight working trade unionists under the leadership of an industrial adviser, William Mosses, who was for many years general secretary of the United Patternmakers' Association and general secretary of the Federation of Engineering and Shipbuilding Trades, to study our methods and practices. Still another group is now in this country on a similar mission.

It is the purpose to consider here only the report made by Messrs. Austin and Lloyd. Apparently they concentrated their observations largely on what may be termed our more progressive manufacturing plants and commercial organizations—24 in all.

"Prosperity," says the report, "is measured by the ratio of wages to the general level of prices; that is to say, even if wages remain constant, a fall in the price level represents an increase of prosperity." And again, "In America during the last few years the ratio of wages to commodity prices has steadily increased and it is evident that this has been brought about by lowering the costs of production of manufactured articles, lessening costs of transportation of all goods by increased efficiency and by the elimination of waste. *The recent marked increase in prosperity in the United States is, therefore, due more to the last-mentioned causes than to indigenous natural resources.*" (The italics are ours.)

What are the fundamental principles of industrial management to which the authors ascribe our success? Here they are in their own words.

1. The success of an enterprise is, in a large measure, dependent upon a strict adherence to the policy of promotion of staff by merit and ability only.
2. It is more advantageous to increase total profits by reducing prices to the consumer, at the same time maintaining or improving quality, with a consequent increase in the volume of sales, than by attempting to maintain or raise prices.
3. Rapidity of turnover makes for comparatively small requirements of both funded and working capital, i. e., the capital required for shop space (including equipment) and the finance of work in progress.
4. The productive capacity *per capita* of labor can be increased without limit depending upon the progress made in time and trouble-saving appliances.
5. It is better that labor should be rewarded by wages bearing some relation to output, rather than by a fixed wage, the amount of the wages earned by any one man being in no way limited. Contrary to the general belief in Europe, high wages do not necessarily mean a high level of prices. It is to the advantage of the community that the policy of industrial management should be directed towards raising wages and reducing prices.
6. A free exchange of ideas between competing firms should be advocated.
7. Elimination of waste is an essential factor in the attainment of national prosperity.
8. It is important that every possible attention be paid to the welfare of employees.
9. Research and experimental work are of prime importance to progress.

Each one of these principles is amplified in a series of short chapters, the most extensive of which covers Principle 4, relating to the productive capacity per worker. A statement in this chapter is of special significance.

"Since every effort should be devoted to increasing the productive capacity *per capita*, use should be made of the intelligence of every worker and member of the staff by providing the proper incentive. In Great Britain it is unfortunately true that an important asset is lying undeveloped in many industries. This asset is represented by the brains of the workers employed. Each worker's intelligence should be utilized to the full for the benefit of the industry. In many cases in British industry the worker is not encouraged to use his brains and the chief reason for employing him is to make use of his manual skill. The fact that a worker may have considerable intellectual ability is too often ignored."

There is no question, judging from the book and these quotations, that the authors of the report limited their observations of American practice entirely to the more progressive industries and modern commercial organizations.

Many railway mechanical department officers and foremen in this country are coming to a keen recognition of the importance of the human element and the responsibility of doing their share in training and helping each man to develop his peculiar talents to the best advantage. One indication of this is the supervisors' and foremen's clubs and classes for the discussion and study of leadership ability. Another is the revival of interest in up-to-date apprenticeship methods.

The railroads have also been active factors in the campaign for the elimination of waste in which this country has now been engaged for several years. The vast expenditures for improved facilities and equipment and time and labor-saving devices have made it possible greatly to increase the unit output and at the same time decrease the cost per unit—the ton-miles per employee. The railroads also stand in the front rank in

* The Secret of High Wages, by Bertram Austin and W. Francis Lloyd, with a foreword by Walter T. Layton, editor of "The Economist." Published by Dodd, Mead & Co., New York. Bound in cloth, 124 pages, 5 in. by 7½ in. Price $1.25.

the emphasis on conservation of life and limb, as embodied in the safety first movement.

And yet we cannot say these things equally of all railroads or of all railway managements. Some excel in one way, others in another. Few follow a balanced program based on all, or even most of the more fundamental factors of scientific management in its broader aspects. Much still remains to be done, even by the leaders. It is, of course, some considerable satisfaction to view the accomplishments of the past few years, but will we be able to keep pace with the growing demands unless we strive still harder and more intelligently to improve our methods and our leadership ability all along the line—to get the most intelligent work and the most loyal co-operation from each individual in the organization?

But to get back to our book. The last few chapters deal with such matters as distribution, company finance, consumption and saturation point, markets and productivity, and the conclusion. It is a comparatively small book, well written and attractively arranged.

Mr. Layton, in his foreword, makes this statement: "In the bad old days, when factory hours were long, there was in every Lancashire town an individual known as the 'knocker up.' Early every morning—often hours before the dawn—the silence would be broken by his insistent tap on one window pane after another down the empty street. Within a few minutes of his passing would be heard first one step, then another, quickly swelling to a roar of clattering clogs, hurrying along the cobbled road to the neighboring mill. Mr. Austin and Mr. Lloyd are endeavoring to play the part of the 'knockers up' of British industry. Let us hope that they will find that the lady is only sleeping and will respond to their call."

We have not yet got to the point in this country, in spite of the optimistic views of the authors of "The Secret of High Wages," where we can get along without the "knockers up." Their observations are based, not on average conditions, but on those existing in some of our more progressive industries. We need "knockers up" in the other industries and in our railway mechanical departments to bring the average up.

Study of air brake tests at Purdue

MORE than 150 railroad men from all parts of the United States and Canada met at Purdue University, Lafayette, Ind., on November 12, to witness demonstration tests made on the freight train brake equipment submitted by the Automatic Straight Air Brake Company. The investigation under way at Purdue is being conducted by the American Railway Association for the purpose of obtaining more economical operation of trains and of promoting safety for the public and railroad employees. Specifically, the investigation is to determine which brake is the most efficient, economical and safest, for stopping freight trains.

This is the most extensive and thorough investigation which has ever been attempted in the history of power brakes for railway trains. Several new systems of brakes have been designed and constructed and are being subjected to these tests to determine if they are better adapted to railway service conditions than the brakes now in general use. The tests are being conducted in a special laboratory, fitted up by the American Railway Association, which contains the entire air brake equipment for the largest type freight locomotive and 100 cars. The tests have been going on continually for a year and will continue for another year or longer before any conclusions can be reached.

As a result of hearings held by the Interstate Commerce Commission about two years ago in the matter of power brakes and power brake appliances, the tests now being conducted at Purdue University were undertaken under the direction of H. A. Johnson, director of research, A. R. A. The basic schedule of rack tests for freight equipment, which began on November 30, 1925, is as follows:

Series No. 1—Run standard K triple valves through schedule of tests in order to determine the exact functions of present standard brakes for a basis of comparison with the new brake systems which will be tested.

Series No. 2—Install heavier-than-standard graduating springs in all K triple valves and determine the effect of these springs upon the functioning of the K triple valves.

Series No. 3—Run Automatic Straight Air Brake equipment through the schedule of tests.

Series No. 4—Repeat schedule of tests for a train of 100 cars with mixed equipments of standard K triple valves and Automatic Straight Air Brake equipments.

Series No. 5—Run new Westinghouse equipments through the schedule of tests.

Series No. 6—Repeat schedule of tests for a train of 100 cars with mixed equipments of standard K triple valves and new Westinghouse equipments.

Series No. 7—If it is found advisable, after completing the six series of tests given above, repeat tests of Series No. 4 or Series No. 6 with mixed equipments of standard type K triple valves Automatic Straight Air Brake equipments and new Westinghouse equipments.

Series No. 8—Install the three-position 10-20-lb. duplex spring type retaining valves, with which the pressure will blow down from a 10-in. cylinder with 8-in. piston travel, or a volume of 640 cu. in., from 55 lb. to 25 lb. in 85 to 95 sec. when in high pressure position and will blow down from 45 lb. to 15 lb. in 45 to 55 sec. when in the low pressure position, and determine the effect of the blow-down time in the high pressure position on the cylinder pressure obtained with the standard type K triple valve.

The tests made on November 12 were typical of Series No. 3, now in progress, No.'s 1, 2 and 8 having been completed, and were made to give the visiting railroad men an opportunity to inspect the equipment and method of procedure used in conducting the investigation. The equipment now on test was submitted by the Automatic Straight Air Brake Company and was designed to meet the tentative specifications for power brakes issued by the I.C.C.

Informal tests

A schedule of informal tests was made for the general observation of the new equipment with respect to graduated release, maintenance of brake cylinder pressure, the ability to obtain emergency pressure at any time, and uniformity of brake cylinder pressure inde-

pendent of piston travel, which are features claimed for the equipment.

The piston travel of the various cars on the 100-car test rack was adjusted as follows:

Four-inch piston travel on cars No. 2, 3, 10, 15, 23, 28, 30, 33, 36, 38, 39, 40, 45, 49, 50, 55, 57, 68, 70, 80, 81, 82, 92, 94 and 96.

Six-inch piston travel on cars No. 5, 6, 8, 16, 17, 20, 21, 26, 29, 31, 32, 35, 37, 47, 54, 58, 66, 69, 72, 75, 90, 93, 97, 98 and 99.

Eight-inch piston travel on cars No. 1, 4, 11, 13, 19, 22, 27, 34, 42, 51, 56, 60, 62, 64, 65, 71, 73, 74, 76, 77, 83, 88, 89, 91 and 100.

Ten-inch piston travel on cars No. 7, 9, 12, 14, 18, 24, 25, 41, 43, 44, 46, 48, 52, 54, 59, 61, 63, 67, 78, 79, 84, 85, 86, 87 and 95.

Test No. 1, *Charging test.*—With a brake pipe leakage of 7 lb., per min. from 70 lb., a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., with the brake valve in lap position and the pressure in the train brake system depleted, move brake valve handle to release position and manipulate the brake valve so as to maintain a brake pipe pressure of 70 lb. at the brake valve of the locomotive.

Test No. 2, *Service application and holding followed by release*—With the feed valve set for 70 lb., and the brake system charged, with a brake pipe leakage of 7 lb. per min. from 70 lb., with a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., make a 10 lb. service reduction in brake pipe pressure and lap the brake valve. Five minutes after the first brake valve movement, move the brake valve handle to full release position for 10 seconds, then place the brake valve handle in running position for the release of all brakes.

Automatic straight air brake equipment on the Purdue test rack

Test No. 3, *Service application, short hold followed by release.*—With the feed valve set for 70 lb., and the brake system charged, with a brake pipe leakage of 7 lb. per min. from 70 lb., a bleed in each brake cylinder which will give a leakage of 5 lb. per minute from 50 lb., make a 10 lb. service reduction in brake pipe pressure and lap the brake valve. Thirty seconds after the brake valve exhaust ceases, place the brake valve handle in full release position for 10 seconds, then place the brake valve handle in running position for the release of all brakes.

Test No. 4, *Service application and holding.*—With the brake system charged at 70 lb., brake pipe and brake cylinder leakage under 2 lb. per minute, make a 5 lb. service reduction in the brake pipe pressure and lap the brake valve for a period of five minutes.

Test No. 5, *Angle cock test.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., close the cutout cock under the brake valve. One minute after the last brake has applied, release the brakes by opening the cutout cock under the brake valve, the brake valve handle being left in the running position throughout the test..

Test No. 6, *Straight-away emergency application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., move the brake valve handle to the emergency position and leave it there for two minutes.

Test No. 7, *Emergency following a service application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per minute, make a 20 lb. service reduction in the brake pipe pressure and lap the brake valve. Two minutes after the first brake valve movement, place the brake valve handle in the emergency position for two minutes.

Test No. 8, *Emergency following release after service application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., make a 15 lb. service reduction in brake pipe pressure and lap the brake valve. Two minutes after the first brake valve movement, place the brake valve handle in full release position for 15 seconds and then place the brake valve handle in the emergency position for 2 minutes.

Test No. 9, *Graduated release test; manual compensation for leakage.*—a—With the triple valves set in graduated release position, feed valve set for 70 lb., and brake system charged, with brake pipe leakage of 7 lb. per minute from 70 lb., with a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., make a 15 lb. service reduction in brake pipe pressure at the locomotive, then manipulate brake valve handle between running and lap positions, maintaining the brake pipe pressure at the locomotive at 55 lb. for three minutes after the first brake valve movement to service position in this step.

b—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 60 lb., then manipulate the brake valve handle between running and lap positions, maintaining 60 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

c—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 65 lb., then manipulate the brake valve between the running and lap positions, mantaining 65 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

d—Make a service application by reducing the brake pipe pressure at the locomotive to 55 lb., then manipulate brake valve handle between running and lap positions, maintaining the brake pipe pressure at the locomotive at 55 lb. for three minutes from the brake valve movement to service position in this step.

e—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 65 lb., then manipulate the brake valve between running and lap positions, maintaining 65 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

f—For final release of the brakes place brake valve handle in full release position for 20 sec., and then place brake valve in the running position.

Test No. 10, *Graduated release test without manual compensation for leakage.*—a—With the triple valves set in graduated release position, feed valve set for 70 lb. and brake system charged, with brake pipe leakage of 70 lbs. a minute from 70 lb. with a bleed in each brake cylinder which will give a leakage of 5 lb. a minute from 50 lb., make 15 lb. service reduction in brake pipe pressure at the locomotive, and lap the brake valve for two minutes from the first brake valve movement to service position in this step.

b—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 60 lb., then lap the brake valve for two minutes from the brake valve movement to running position in this step.

c—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 65 lb., then lap the brake valve for two minutes from the brake valve movement to running position in this step.

d—Make a service application by reducing brake pipe pressure at the locomotive to 55 lb., then lap the brake valve for two minutes from the brake valve movement to service position in this step.

e—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 65 lb., then lap the brake valves for two minutes from the brake valve movement to running position in this step.

f—For the final release of the brakes place brake valve handle in full release position for 20 seconds and then place brake valve handle in the running position.

In order to obtain accurate information concerning the functions of all the air brake equipment tested and to be able to compare the data collected on standard type K equipments and the new types submitted a complete

system of analyzing the data from observation and trainagraph records has been installed.

Assisting Mr. Johnson in this work are A. A. Potter, dean of engineering and director of the Purdue University Engineering Experiment Station; G. A. Young, professor of mechanical engineering; W. S. Helmer, representing the A.R.A.; Harry Rubenkoenig, professor of railway engineering, and a large staff of engineers who perform the tests and tabulate and record the data. When the air brake investigation is completed definite statements can be made as to the desirability of new types of brakes as recommended by the I.C.C., the economy of proposed changes and the feasibility of making new installations of newer types of brakes.

Operating passenger trains without angle cocks*

Pennsylvania makes tests in general passenger service to determine practicability

By *W. H. Sitterly*

General car inspector, Pennsylvania, Buffalo, N. Y.

SEVERAL years ago, the management of the Pennsylvania became satisfied that the angle cock could be eliminated from passenger equipment without detriment to the service, in so far as increasing the time required in switching passenger trains is concerned, and outlined a test at Harrisburg, Pa., where a large percentage of the trains operating through that point are broken up. The test was satisfactory, as it developed that no more time was required to switch a train without the use of angle cocks than with them. Recently the same test was made simultaneously at all passenger terminals on the Pennsylvania Railroad with about the same success as was obtained at the first test at Harrisburg.

The Train Brake and Signal Committee of the American Railway Association, Mechanical Division, became interested and conducted a series of tests at terminals on various railroads in the United States.

Early in August our management decided to eliminate the angle cock by locking the handle in the open position, the brake pipe being closed at the rear of the train by attaching the hose to the dummy coupling provided for that purpose. The date set for this operation to begin was 12:01 A. M., October 1, instructions being given that all angle cocks should be locked in the open position within a period of 72 hr. after that date. All railroads with which passenger equipment cars are interchanged were notified of the effective date of locking angle cocks on all passenger equipment cars. On the Northern division, the New York Central heartily co-operated with us in this operation, both at Exchange Street Station, Buffalo, and at Erie, Pa.

Method of preparing cars

Before going into the supplementary instructions to train service employees in the handling of trains of cars with the angle cocks open, locked in the open position, I might say that the operation was a very simple one. A lock was stamped out of sheet steel. The small orifice is intended to go up over the angle cock handle to keep it from being raised by train service employees. In locking the angle cock handle, it has to be raised before it can be placed in the closed position. The large orifice, after this clamp was placed over the handle of an angle cock, registered with the opening in the angle cock, then the hose, or hose extension nipple used with a type "D" coupler, was applied. This absolutely locks the angle cock in the open position. Presumably instructions will be issued at some time in the near future that when our passenger train equipment goes through the shop for repairs, the angle cocks are to be removed. There will be no loss, because all angle cocks used on passenger cars are bushed from 1¼ in. to 1 in. The only thing necessary is to remove the bushings which will make them available for freight equipment cars. The brake pipe at the end of the train is closed by coupling the dummy coupler into the hose coupling. That is the only interruption from the head end of the train to the rear end.

Supplementary instructions to the Air Brake and Train Air Signal Instruction Book 99-A-1 for attaching and detaching locomotives or cars in passenger train service without the use of brake pipe angle cock, for the guidance of employees who are engaged in the maintenance or operation of locomotives or cars in passenger train service, were issued under date of August 9, 1926, and are as follows:

Instructions for attaching and detaching locomotives or cars in passenger trains

The angle cock handles on all locomotive tenders and cars used in passenger train service will be securely clamped in the Open position, except those on shifting locomotives. The brake pipe stop cocks on the front end of all locomotives will not be modified and may be used as at present.

A—When trains are not broken up and change of road locomotive only is required

Arriving train—After stop is made, engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until a signal is received for a release. The air brake hose shall then be parted between locomotive tender and car. The air brake hose coupler on the locomotive tender will then be placed in the dummy coupling, after which a signal should be given to the engineman for a release of the brake. The engine will be cut off in the usual way.

Departing train—After the road engine is coupled to the train, the engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until a signal is received for a release. The inspector will then remove the hose from the dummy coupling on the locomotive tender, and unite it with the hose coupler on the first car in the train, and then signal

*Abstract of a paper presented at the October 14 meeting of the Central Railway Club, Buffalo, N. Y.

the engineman to release the brake, except in cases where a change is to be made in the make-up of the train by a shifting locomotive from the rear. The engineman in charge of the road locomotive must not release the train brakes until the shifting has been completed. The usual air brake tests will then be made after the brake system has been charged to at least 70 lb.

B—WHEN TRAINS ARE BROKEN UP WITH NO CHANGE OF ROAD LOCOMOTIVES

Arriving train—After stop is made, engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until all shifting movements have been completed. The engine and tender brakes may be released, if necessary, by the use of the independent brake valve.

Switching road train—All switching of cars should be controlled by the air brake. The air brake hose on the rear of the rear car (furthermost from the locomotive) in draft shall be coupled to either the dummy coupling on the car or the back up hose. After the shifting engine has coupled to the train and the hose coupler united, the trainman will open the angle or stop cock on the shifting locomotive to release the air brakes on the cars in the train.

When setting off or picking up cars in a train that is being shifted, it will be necessary for the engineman on the shifting locomotive to make a service brake application of 25 lb., after which he will place the brake valve in emergency and leave it there until he receives a signal for a release of the brakes. The trainmen or inspectors will separate the air brake hose couplers where separation is to be made in the train, and couple them to the dummy couplings or standard back-up hose before signaling for a release of the brakes.

When shifting trains without the use of angle cocks, it will be necessary to deplete the brake pipe pressure before any separation can be made, which should be done by making a service application of 25 lb., after which the brake valve should be placed in emergency position until a signal is received to release the brakes. Dummy couplings which are standard for all passenger locomotives and cars, or the standard back-up hose and alarm whistle must be used for closing communication between the brake pipe and atmosphere when making train movements.

The speed of trains while shifting, should be controlled by the air brake, and in no case should shifting or road movements be made unless the brake system is charged to at least 70 lb.

Handling the trains in service

It was my privilege to witness the operation at our passenger car storage yard on the morning of October 1. Our trains arrive and depart from the New York Central station at Buffalo, making it necessary to back them into the station. The movement of the train, so far as the brakes are concerned, is controlled by a pilot on the rear end. Our instructions to enginemen are to lap the brake valve whenever they are approaching a tower or a point where a stop is liable to be made, thereby placing in the hands of the pilot an opportunity to make whatever reduction in the brake pipe he desires without having the air blowing from the main reservoir into the brake pipe as fast as he is trying to draw it down.

On the trains I noticed on that particular morning the pilot came down through the yard and hung the back-up hose on the gate of the Pullman car after which he got up on the platform. He gave six blasts of the communicating signal to the engineman to deplete the brake pipe pressure so that he could couple up the back-up hose.

Immediately after the brake pipe was depleted he stepped down, connected up his back-up hose, and then gave the engineman a signal to release the brakes. After that was done the pilot followed further instructions that he must make a test of the brakes before he leaves the empty car yard, to know that he has control of the brakes from the rear end of the train, and after he was satisfied that the brake system was recharged, he gave the engineman the usual signal to lap his brake valve and applied the brakes by the use of the back-up hose. He then got down on the ground, went over the train as far as the engine to see that all brakes were applied, came back and gave the engineman a signal to release the brakes.

Railway correspondence

The art of letter writing could be studied to good advantage by all railway officers

By J. M. Ganley

Chief clerk, passenger traffic department, Wabash, Detroit, Mich.

MANY thousands of letters, requisitions, reports and other written thoughts are promulgated every day in all departments and branches of a railroad. Very few persons employed on a railroad in these days are exempt from letter writing in some form or other. It is a subject of considerable importance, but, unfortunately, in too many cases it is not given the thought and attention it deserves. This lack of study usually results in the increasing of the amount of correspondence, a large percentage of which could be avoided.

To the average railroad man, letter writing is the hardest task to be performed. In fact, it is considered a useless and obnoxious art by a good many. Why? Because they have never given enough attention to the matter of making the other fellow understand their written thoughts. Some of the most successful foremen and higher officers are the poorest letter writers. It is extremely difficult for the average man to put on paper just what he wishes to say, but a simple remedy for this is to say it the way it would be said if the party for whom it is intended were immediately before us; of course, leaving off certain expletives.

It is not necessary to start a letter with such expressions as, "Your favor of the 13th inst. received, and contents duly noted"; "In reply would state that, etc."; or "We beg to acknowledge receipt of your favor of the 29 ult., and in reply permit us to advise you, etc."; or "In reply to yours of the 27th, I beg to state that," or "For your information." These are old, useless, stereotyped expressions that are outworn and meaningless and only take a lot of time to write.

Take for example the following: "Your favor of the 13th inst. received and contents duly noted. In reply would state, etc." In the first place, why "favor." Is it not a letter of which the writer is writing? Then why not use the right word? "Favor" is affected, indirect and stereotyped. And why "contents duly noted"? Many reams of good letter paper have been filled with that perfectly useless phrase. Of course, the contents were duly

noted. It is a natural supposition that if a man replies to a letter at all, he has given it sufficient attention to know what he is writing about. If the letter has been interesting, or surprising, or has grieved us, or particularly pleased us, we should say so, if we want to, but we should not waste time and space by conveying the useless information that we have read it.

"In reply would state," that is almost as bad as "Contents duly noted." If mention has been made of the receipt of a letter, it is obvious that the letter being written is in reply to the one mentioned, and it is wholly unnecessary to state that fact. Then, again, what is the reason for "would state"? It is simply sufficient to state what is to be stated without telling the reader that this is about to be done. In other words, there are five words that are absolutely unnecessary in the second sentence, and many superfluous ones in the opening sentence.

In regard to the second phrase, "We beg to acknowledge receipt, etc.," why "beg"? Is permission necessary before one may reply to a letter that he has received? The dictionary meaning of the word "beg" is "To ask earnestly for; to entreat or supplicate for; to beseech.' A dog will beg for a bone, but why should a letter writer beg?

In the first place, no doubt, the letter you are acknowledging told you to do so. Then why ask permission for something you already have? It would be much better to simply say, "Your instructions have been received, etc."

"Thanking you in advance." This expression is used frequently, but it is absolutely improper and impolite, as it imples that the person being asked must grant the favor and that you will not take the trouble to thank him after he does grant it.

The importance of punctuation

One subject of importance in every written thought is punctuation. The present-day tendency in business letter writing is to reduce to the minimum the number of punctuation marks used. So far as this brings about the elimination of unnecessary punctuation, the tendency is good, but it is illogical and wrong when carried to the extent that it does away with necessary punctuation. Punctuation is not a matter of personal taste, nor does it depend entirely on good usage. It has two definite purposes to perform; it should make printed or written matter easy to read, and it should help to guard against the writer's meaning being misunderstood by the reader. Good usage determines the kind of punctuation marks that are to be used, but these two purposes determine when they are to be used. Anything that saves time in the transaction of business is worth careful attention. The time saved by the writer who leaves out punctuation marks is so small that it is negligible, but if the reader's time is saved by the insertion of a comma that is necessary to make the meaning clear, it is certainly worth the writer's time to put the comma in.

If the only purposes of punctuation are to make a letter easy to read and to guard against possible misunderstanding, why is it necessary to have any rules on the subject? Why should each writer not be left to decide for himself the places where it is necessary to put punctuation marks in order to make his meaning clear and to facilitate reading? If one were able to see his work as it looks to others, this might be feasible. Whatever one writes, however, is so plain to him that he does not see how it can fail to be plain to everybody else. Therefore, in order to be sure that it will be understood by others, we must apply the rules of punctuation that have been formulated after a careful study of the situations in letters that are most likely to give rise to misunderstandings. These rules are simply the expression of the best usage of conventional practice.

If the rules require a period at the end of every sentence, it is because that is the best way to make the words easily read and to insure the thought being correctly understood. It is true that sometimes in some places the omission of punctuation marks prescribed by the rules would not make the matter particularly hard to read, and would not seriously interfere with the reader's understanding of the intended meaning. No writer, however, is capable of determining this matter for himself. It is best to be always on the safe side, to be absolutely sure that everything possible has been done to make the letter easy to read, and to make impossible any misunderstanding of the writer's meaning.

It may be said, "Well! That is all good enough for a scholar," or that it shows too much "book learning." We are living in an age when we cannot see and talk to everybody we deal with; therefore, we must use some other method of letting him know our thoughts, and if it is necessary that we write, why not write clearly, so that the other fellow will know what we are trying to say?

Letters should be correct and easy to understand

A good many things come under the heading of "correctness." For instance, the size and kind of paper to use and whether or not to write with a pen or pencil. In addressing a superior officer for an increase in wages, or some particular favor, it would not be advisable to scribble a note across some dirty half sheet of yellow paper or on the back of an old envelope. Correctness also means good grammar and correct spelling.

Clearness. If the person who receives a letter is not able to understand what it tries to say, the writing of that letter has been a waste of time. If a letter is worth writing at all, it is worth writing in such a way that its meaning can be understood. If it is not written in that way, there can result only trouble and delay. This also applies to requisitions, time slips—in fact, anything written, for what good is written information if it cannot be read and understood?

When making out a requisition, it is necessary to describe all items accurately and completely. Don't be afraid of being redundant, or saying more than may be absolutely necessary in describing what is wanted. Say too much rather than too little. A good rule to apply here, as well as in writing of every kind, is "Write not only so that you may be understood, but so that you must be understood." We can never go wrong if we keep this objective in mind.

An illustration of the lack of clearness and, in fact, what was actually carelessness, in making out a requisition is given in the following case. A general car foreman ordered some flue reamers. What he wanted was flute reamers. He did not state whether the reamers were to be high speed or carbon steel, and the result was that a letter had to be written asking for the necessary information.

In another case a road foreman of engines made a voluminous report on the condition of a locomotive, but, in his zeal, overlooked the engine number.

There are hundreds of these cases daily and everyone of them means letters and wasted time, whereas a little thought in the first place would save a lot of time and criticism.

Conciseness means brevity, but it also includes completeness. In other words, conciseness means that a letter should be as short as possible, but that it should also say everything that is necessary under the circumstances.

The number of words used is less important than the number of thoughts and the manner in which they are expressed. There are many letters that cannot be both complete and brief, and completeness should never be sacrificed for brevity.

Shortly after the shopmen's strike in 1922, a young man wrote an appealing letter to a superintendent of motive power on a certain railroad, stating that he had served 18 months of his apprenticeship when the strike was called, and asked if he could be allowed to continue and credit be given for his past experience. As men were needed at that time, his request was granted by letter. But the young man never received the letter from the superintendent of motive power as he had failed to give his street address, and the reply was returned unclaimed. We do not know if the young man ever got another chance like that, but no one was to blame but himself. He may have had his address on the envelope, but that envelope, with a hundred others, had found its way to the waste basket and was probably burned before the letter was answered.

Another important point in letter writing is courtesy. A discourteous letter does no good, and if we receive one and answer it in the same strain we only make matters worse. It is always good policy not to write when angry, but *if indignation must be expressed, write the strongest, most discourteous letter you can, and then tear it up.*

A story is told about Secretary Seward who came to President Lincoln with a very severe letter written to a man who had proved himself an out-and-out scoundrel. Mr. Seward hesitated to present it to his chief, but, to his delight and surprise, Mr. Lincoln exclaimed with pleasure, "Only that is not half strong enough. Go back and write it over." Mr. Seward responded with pages that fairly burned. "There," said Mr. Lincoln, "that is just what the rascal deserves." "All right, Mr. President," said Mr. Seward, "I will send it right off." "Oh, no!" said Mr. Lincoln, "don't send it. Throw it in the waste basket."

If you must get angry, do it outside the office or shop. In the first place, you may be wrong in some of your assumptions. The other fellow may be careless, but not criminal, and he may mean well, not ill. Something may have happened so that he could not do what was wanted. Another thing: he may get angry and stubborn and cause more trouble.

Courtesy is a good implement to use when dictating to a stenographer. Stenographers are only human and are not mind readers. Too much should not be left to the stenographer. It is necessary that the dictator do the thinking. It is a good and commendable practice to educate stenographers to do a certain amount of the routine work without assistance, but the important matters should be handled personally. The most annoying and difficult part of a stenographer's job is to take dictation from a person who does not know clearly what he wants to say, or who mumbles and articulates indistinctly.

Another thing, it is not a good practice to trust the work turned out by a stenographer too much. Read your letters after they are written, because it is your signature that goes on the bottom: if anything is wrong with the letter you are the responsible party.

A particularly bad practice is the scribbling of notes or letters for the stenographers to transcribe. In the present day of the typewriter and printed matter, handwriting seems to be a forgotten art; why inflict such punishment on a stenographer and then wonder why the work does not come back to you sooner?

In common courtesy to the other fellow, always mention his file number and the date of his letter that you are answering. This saves considerable time of file clerks and does not allow any chance for misunderstanding.

Only one subject should be included in a letter

Only one general subject should be included in a letter, otherwise there is bound to be a lot of confusion and needless copying of letters so that the various subjects can be properly filed.

A bad railroad practice is the use of initials on telegrams, copies of letters, etc. This may be all right when the paper is not to go out of the immediate office in which it is written, but there is too much chance of the wrong fellow getting the papers, causing delay and extra handling.

Abbreviations should not be used unless they are so clear they cannot be misunderstood. Just what does "R & R" mean? Read and rewrite, remove and repair, remove and replace, or what?

In railroad work, instructions are frequently sent out from the general office, and these instructions are to be passed on to others. In these cases, it is bad practice to quote the letter of your superior officer or post a copy on the bulletin board. It is much better to revamp the letter, over your own signature, and convey the same information.

The too frequent use of that big personal pronoun "I" is obnoxious and often spoils a letter that in other respects is very good.

The "tracer" or "puncher" letter

There is one kind of letter, thousands of which are written daily on the railroads, which should be unknown. I refer to those letters known as "tracers," "punchers" and by numerous other names. We should be ashamed to receive such a letter. Common sense and common politeness should indicate to us that every letter requiring an answer should be answered and answered promptly. If all the information is not available, say so, but do not wait until somebody prods you into action with numerous, and sometimes very sarcastic "tracers." Such a communication means a lot of unnecessary work. First the file clerk has to get the letter out of the file and take it to the desk that wrote the original letter. Then the stenographer has to write a tracer, which goes to the other person who has to look for his file, match up the papers, find out what has been done and then reply. Practically all of this could have been avoided if he had taken time enough to have answered the letter at the proper time.

The biggest trouble with the average letter is that the recipient does not read the letter carefully and thoroughly and, in most cases, does not grasp what the letter has said, which means more correspondence and a useless waste of time and money. Every letter that is important enough to be written is important enough to be read carefully and, if at all complicated, it should be studied. Many railroad letters are skimmed through daily and only one or two of the main points absorbed by the reader who makes a vague reply and only partly covers the subject.

Letters of commendation and censure

There is a type of letter that is very little known in railroad circles, although there is no doubt as to its value, if properly used. This form of letter takes more time and pains than the ordinary letter of instruction or criticism, but the result is generally worth the effort. The writer refers to letters of inspiration or commendation for some good performance, or to coax along a weak brother who only needs a little coaching and encouragement to make him "hit the ball." Assume for a minute

that you are a car foreman at some outlying point with only a handful of men working with you where you were "sweating blood" every hour of the day to keep things moving and you received a letter like this from your boss:

What is the matter with the bad orders at your station? You certainly are not getting results and, if some decided improvement is not made in a short time, drastic action will have to be taken.

You would probably wire the boss to send another man on the first train, but, on the other hand, you might have certain obligations of more importance to you than your personal feelings and would not be able to take such action. Would not a peppy, inspirational letter like the following be more successful and would it not make you feel like digging in harder?

The first of the month will be just 15 days away when you receive this letter—just 15 days for you to make the best showing on bad orders and hot boxes this year. We are doing it at all other points on the division, and I know that you can do the same. So far this month, you have not done so well, but I know you will dig in and help us make the best record ever made on this division. Watch the packing of boxes closely.

You have the ability, Tom, and I know you will not fall down on us.

Consider the enginehouse foreman after he has had a visit from a federal inspector, who has tied up several of his locomotives. It would not pay to increase the load on his already overburdened shoulders. If he is any kind of a foreman at all, he keenly regrets the results of the inspection. Most likely the transportation department is hounding him for the locomotives. Maybe a few of his best men are off sick, the air compressor is not working properly, or something else is wrong. He needs encouragement now, more than at any other time. A sassy, impudent letter reflecting on his ability would certainly do no good. Would he not feel much pepped up and ready to dig in again if he got a friendly letter from the boss, something like the following:

It is too bad that the government inspector had to tie up the 1302 and the 993. No doubt, you had a hard time to recover from the mess.

I notice that you got clear records on six locomotives. That is very good and shows that you and your inspectors are alive to the situation and on the job. Keep up the good work, and particularly impress on the men the necessity for remedying the small defects.

So far this month, we have done very well on this division and your six OK's helped to boost the average.

While we dislike to get the red cards, I think I appreciate your feelings and I feel sure that the next time one of the inspectors shows up he will find nothing to report.

I expect to be in on No. 7 Thursday and will talk over the situation with you.

The hardened railroader will probably laugh at this kind of letter, but is it not better than the ugly, sarcastic kind which only tends to make the receiver ugly and stubborn? Of course, it would not be advisable in all cases to use this type of letter as there are still a good many old-time foremen who must be driven and toward whom the "come along" attitude is useless.

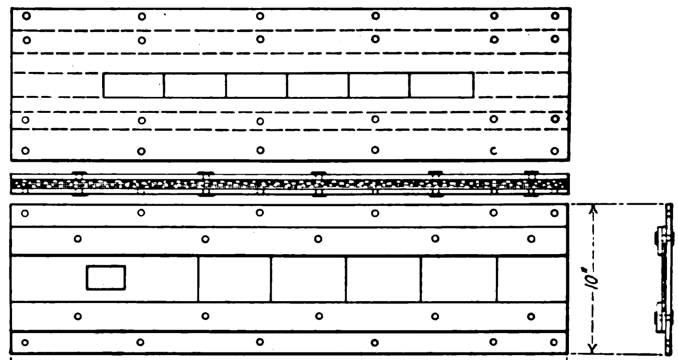
Keeping cold air out of the cab

By J. E. Allen

The device, shown in the drawings, for keeping cold air from blowing up through the slot in the cab floor around the reverse lever will be appreciated by many enginemen. It has been used successfully on one road for some time and a number of favorable comments have been received, especially during last winter.

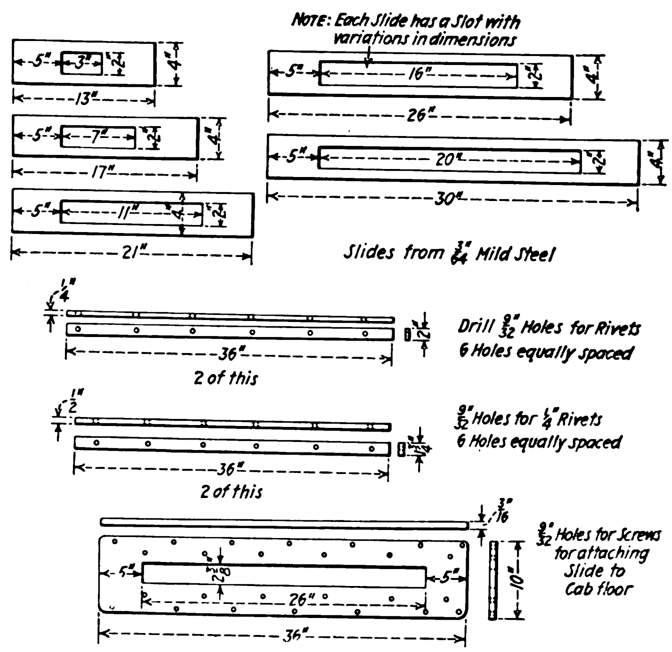
The device consists of a base plate of 3/16-in. boiler plate, provided with a ways in which slide a number of plates, laid one on top of the other. The base plate, 10 in. by 36 in., a detail of which is shown in one of the drawings, has a slot 2⅜ in. by 26 in. cut lengthwise in the center which allows free movement of the lever. The ways for the slides are also made of boiler plates, the flange piece being ¼ in. thick by 2 in. wide and the filler piece ½ in. thick by 1¾ in. wide, allowing a ¼-in. flange over the slides.

The slides, shown in one of the drawings, are 4 in. wide and are made of 3/64-in. steel. Each slide has a slot



A collapsible reverse lever slide for keeping cold air out of the cab during the winter

2 in. wide cut out along the center. When assembled on the locomotive, the reverse lever extends up through the slots in the slides which are placed in the ways of the base plate. The bottom slide is 30 in. long and has a 20-in. slot cut in the center. The 26-in. slide is placed on top of the 30-in. and thus in order of length with the 13-in. slide on top. The slot in the top slide fits snugly around the reverse lever and as the reverse lever is moved either for-



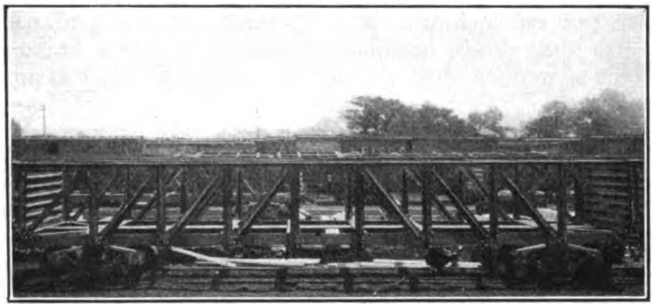
Drawing showing the detail construction of the slides and base plate

ward or backward, it successively comes in contact with the ends of the slots in the lower slides, which then are carried along with the reverse lever. Each slide, however, covers the slotted opening in the slide underneath. Thus, regardless of the position of the reverse lever, cold air is prevented from coming up through the floor of the cab.

Rebuilding coal cars at Yale car shops of the Frisco*

An average daily output of ten 40-ton gondolas is obtained with a working force of 225 men

YALE, Tenn., lying just out of Memphis, was chosen in 1912 as the logical place for the repair of Frisco cars. Light repair tracks and light equipment were installed and until 1918, a small force of men was maintained at Yale to handle the light repairs to all classes of equipment that found its way to the Southern division and needed attention.



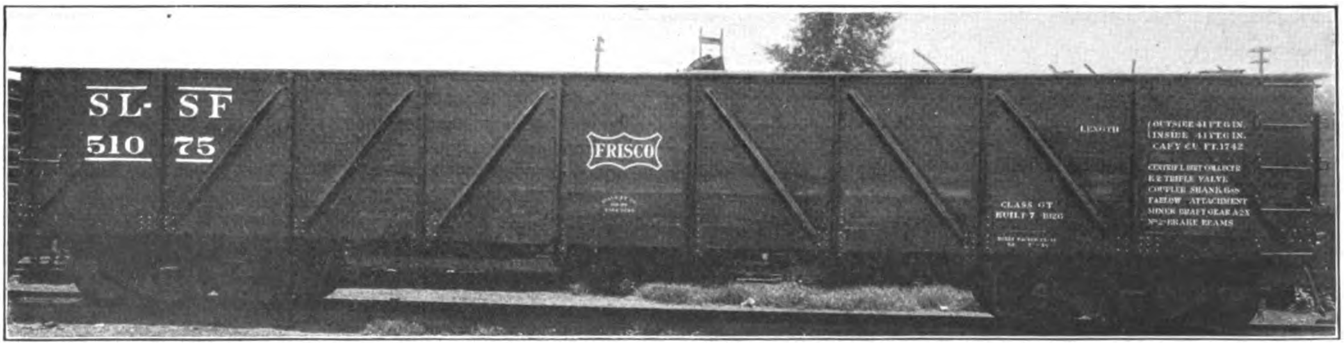
Two workmen ream 1,000 holes in 30 minutes

*An abstract of an article which appeared in the September, 1926, issue of the Frisco Employees' Magazine.

In 1918, the favorable location of Yale to the Southern division and its close proximity to the rapidly growing coal fields of Alabama, combined to bring it up from the light repair class to a heavy repair plant, and the capacity of the yards was increased.

The car frame is laid on the ground in which position the air cylinders and all draft attachments are applied

It was, in addition, freed from the work of repairing all classes of equipment, and designated as the only

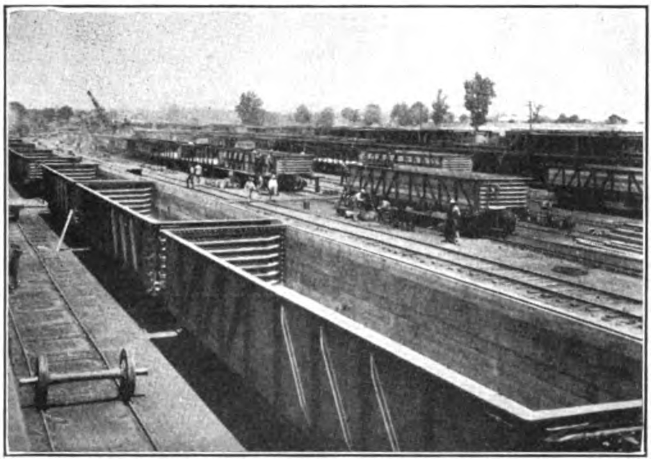


The finished product

hopper car repair shop on the Frisco, receiving only coal cars for repair.

In 1921, the Yale yards had proved out and were moved up another notch in the Frisco's rapidly growing organization, and designated as car building yards. During 1921 and 1922 the Yale yard force of workmen built 80,000 lb. capacity, all wood coal cars at an average of 50 a month, turning out 1,200 of these cars in the 24-month period. During the months from July, 1922, to January, 1923, inclusive, the yards were shut down, owing to the strike, but on January 1, 1923, the Yale plant opened again.

This time work began on a still larger scale, and 130



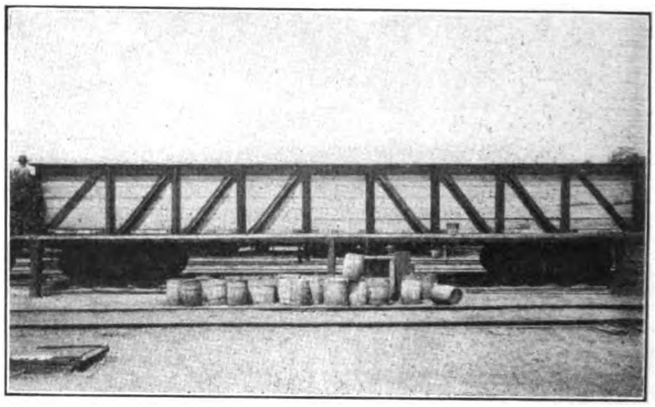
A general view of the Frisco car repair yards at Yale, Tenn.

men again began turning out the 80,000-lb. capacity gondolas at the rate of 50 a month. The coal tonnage of the Frisco was growing by leaps and bounds at this time, and more and more cars were needed to haul the coal from the Alabama fields. During 1923, another 1,200 of the 80,000-lb. capacity, all-wood gondolas were turned out, and in 1924, the yards expanded further and increased the monthly average from 50 to 65 cars.

There was a heavy demand for equipment in 1925, and the first four months of that year found the yards at full capacity. Four hundred of the government type coal cars were turned out during January, February, March and April—an average of 100 a month. The rest of the year the average of 50 a month was carried on.

For the first four months of 1926, the Yale plant was marking time waiting for material for new cars. But on the seventeenth day of May, a force of 225 men—an increase of 125 per cent since 1922—started on an order of 950 coal cars.

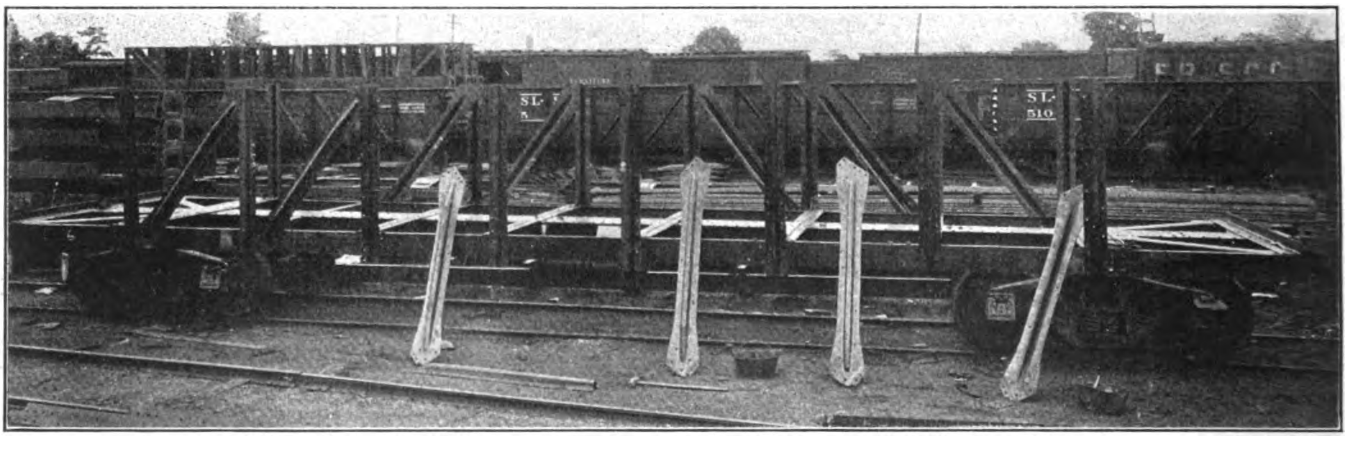
During the 12 remaining days in May, the men under car foreman Jake C. Lutz, turned out 50 cars. In June, 228 cars were built with the same 225 men—a car and a fraction to each man. In July they averaged ten cars a day, and the average for August was slightly better.



Six men place twelve 2½-in. by 9¼-in. by 42 ft. fir side boards on a car in approximately 35 minutes

The Frisco is both spending and saving money in the Yale yards. The expense now approximates $450,000 a month at Yale and the force is turning out an average of 250 cars a month. Each car is valued at $1,800.

The most rigid economy is maintained in building the new cars and the saving is shown monthly in the saving per car. The trucks for the new cars come to the Yale yards from all over the Frisco system. The truck bolsters are changed, two new cast steel truck side frames are put on each car, a new spring channel and new truck springs are installed all around, and new brasses, journal wedges, dust guards, box packing, brake beams and brake beam hangers, hanger pins and brake connections, put in. This is done to each set of trucks before they are considered fit for the new equipment.



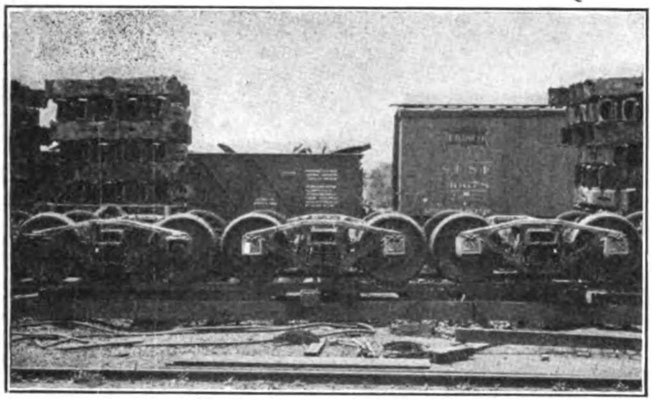
At this position all the stakes and braces are riveted in place in 45 minutes

Method of rebuilding the cars

The trucks leave the truck shop for the first position in the car shop and are put on the building track. The body is lifted on the trucks by a Brown hoist. The fit-up men place all stakes and braces in 30 min. after which the car is moved to the next position where 1,000 holes

are reamed in about 30 min. Then comes the driving position where a crew of 16 hammermen, buckers and heaters, rivet the 1,000 holes in about 45 min. Then the car is floorboarded with another crew of six men in about 35 min. and after one more operation in which safety appliances are put in place, the car is cleaned for the painter. Three coats of paint are applied, the first a coat of Brown primer, and two coats of carbon black. Three days are consumed in this operation after which the car is stenciled.

There is a friendly rivalry among the men on the



Fifteen men are engaged in dismantling and in rebuilding trucks which are sent to this point from all over the system

building tracks that is the very essence of good workmanship. It is a tradition on the building tracks that the Brown hoist must not wait long for a car to be finished in one position, until it is moved to the other. If the hoist approaches the driving position, the men will speed up their hammers and redouble their efforts. As a result the engineer of the hoist will see in record time his hook attached to the car for the short trip to the next group waiting to put it through the next process.

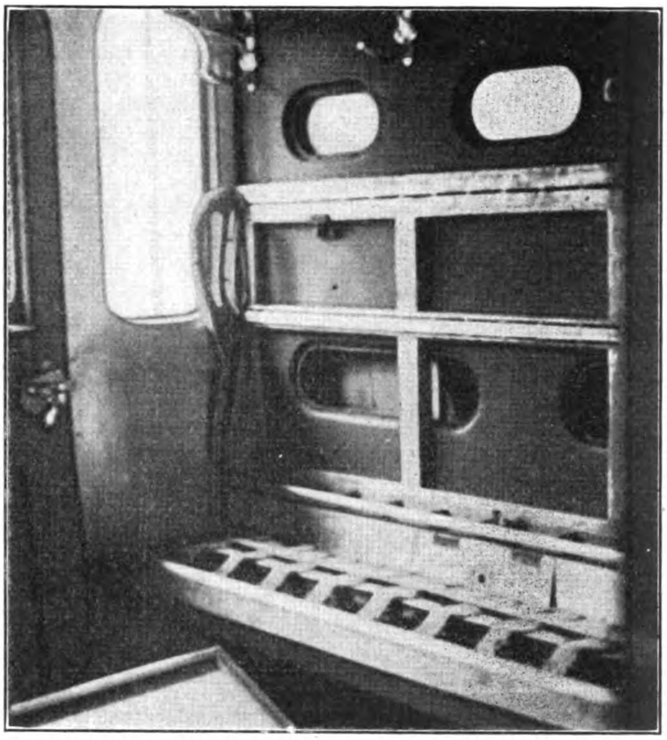
All-metal passenger cars built in France

By A. Eisenschmidt

Chemin Ste Barbe, Gaillon, Ense, France

A PASSENGER car of all-metal construction was exhibited by the Compagnie des Chemins de Fer du Nord Francais at the Exposition des Arts Decoratifs which was held at Paris last year. The body of this car is 64 ft. long, with a length over the buffers of about 66 ft. The distance between truck centers is 44.42 ft. The object of the designer was to construct the body of the car so as to have the same stresses as would be set up in a hollow beam under the same load and reactions. The underframe consists of two side sills tied together at the center by a single cross-piece riveted to a cast steel block which in turn riveted to the side sill. The trucks are pivoted on pressed steel plates, a top view of one of which is shown in an illustration, riveted directly to the side sills in lieu of the usual form of body bolster. The underframe has also additional bracing of steel plates stamped to the desired shape.

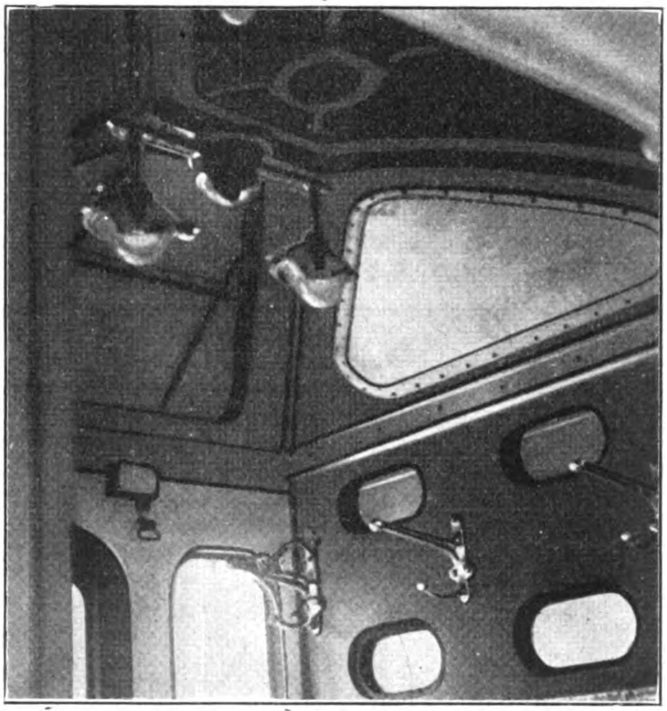
The body of the car, shown in one of the illustrations, is constructed entirely of steel plate, the various parts of which have been pressed to shape. The side and end pieces are of 5/32-in. steel plate, cut and stamped to shape, including the openings for the doors and windows. The length of each side sheet corresponds to the width of a single compartment, each single sheet having openings for one door and two windows. The side sheets are riveted and soldered together. The ends are stamped and



Interior view of one of the compartments, showing the construction of the seats and division walls

cut, as shown in one of the illustrations, with one vertical and two diagonal braces.

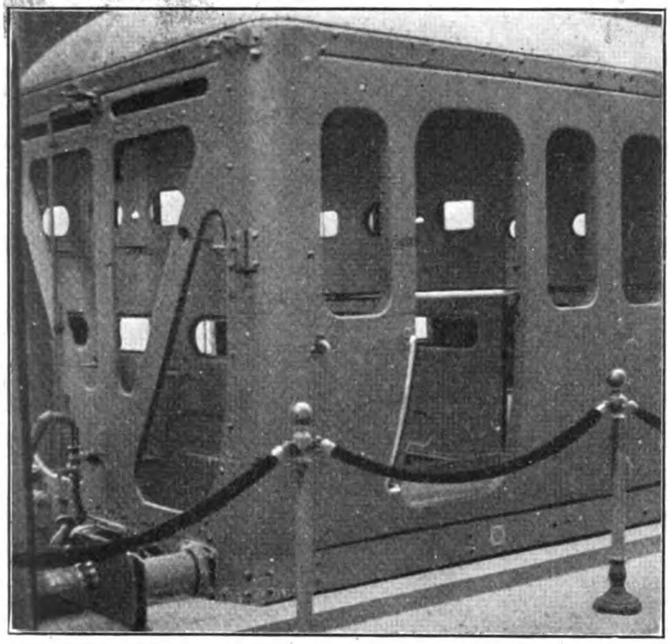
Between the compartments are partitions each made of



Interior view of one of the compartments, showing the construction of the roof and top part of the division walls

two steel plates about 1/8 in. in thickness. These plates are placed side by side, making a partition, including an

air space, about 1 9/16 in. in thickness. A door is provided in each partition to allow room for a passageway along one side of the car, the door openings in the two partition sheets being stamped out. The two plates in each partition are secured together by means of rivets and soldering to reduce any vibration and are designed to provide additional strength to the body of the car. The doors are made of steel plate stamped to fit.



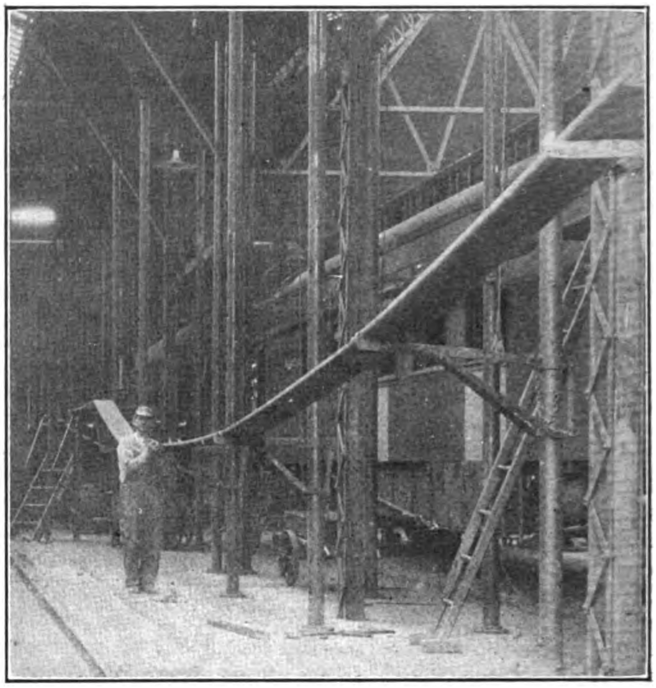
View showing the end and part of the side construction

A total of 82 seats are provided in the car, of which 33 are for second-class and 49 for third-class passengers. Each car is equipped with toilets, steam heat and electric lights. The style and character of this equipment, of course, varying according to the class of service.

A flexible scaffold for the coach shop

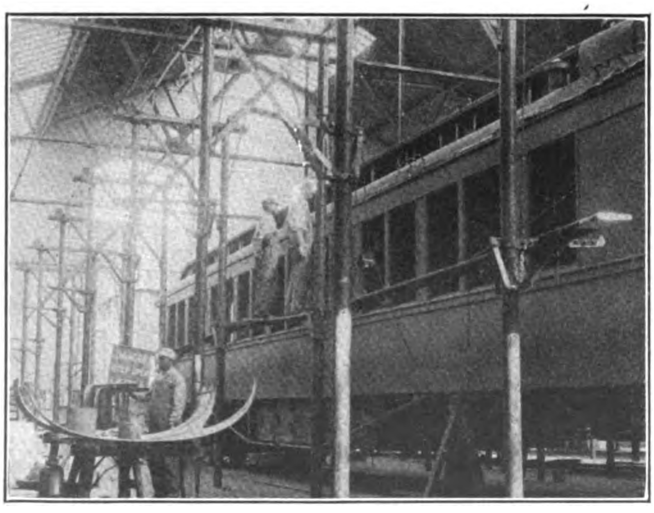
By Charles W. Geiger

A NOVEL design of scaffolding is being used in the coach shop of a western railroad which has proved to be convenient for carpenters or painters who are working on the roof or side of a car. The platform consists of 2-in. by 12-in. planks, hinged together at the ends with a pin. A notch 6 in. wide by 3 in. deep is cut in one end of the plank and a tongue slightly less than 6 in. by 3 in., to fit in the notch of the adjacent plank, is cut on the opposite end. A hole for about a ½-in. pivot pin is drilled through the lugs formed by the notch, about 1½ in. back from the end. A pin hole is also drilled through the tongue so that the pivot pin can be easily inserted to join the two planks. Both ends of the plank are reinforced with sheet metal placed around the end and secured to both the top and bottom about 12 in. back from the end. The platform is supported on brackets clamped to 4-in. pipes.

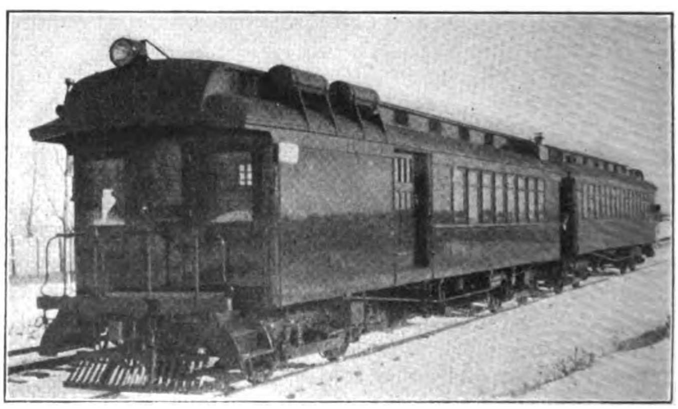


The ends of the planks forming the platform are hinged together to provide flexibility

The flexibility of this type of scaffolding enables the workmen to reach any part of the outside of a car and the edge of the roof with a minimum of adjustment. One or more men can work at the top of the car at one or both ends, while other workmen can work at a lower level at the center.



Another view of the flexible scaffold showing the rear construction of the metal bracket



Standard 36-ton railway passenger coach converted to motor drive by the Chicago & North Western—The car is equipped with two gasoline motor driving units built by the Oneida Manufacturing Company, Green Bay, Wis.

Balancing factors in the use of freight cars*

A discussion of the aspects of design from the standpoint of operation and utilization

By L. K. Silcox
General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago

IN 1901 the Pennsylvania built the first 50-ton box cars because of having a greater earning capacity than the 40-ton cars. An analysis of the real benefits in operating 50-ton box cars must take into consideration two important points, viz.; can the greater loads they can carry be obtained? If so, what is the greater carrying capacity during a given period over and above the additional first cost? What is the cost of hauling the extra dead load of the heavier car?

Many thousands of 50-ton capacity box cars have been added to the equipment of the railroads in recent years and large numbers are now under construction for future delivery. It seems not inappropriate to raise the question as to whether the results obtained from the use of the 50-ton car in actual service will justify its extended employment in most localities as a standard car, in place of the 40-ton car. Will these results, when properly analyzed, not show that the 50-ton car, from a practical or commercial standpoint, can only be regarded as a specialty and confined to a particular class of traffic in a territory where the limits of its usefulness are governed by well determined lines of demarkation? An analysis of this subject necessarily involves a collection or compilation of itemized data on the essential factors that have a bearing on the relative value of this car compared with the others above mentioned. Among the most important factors are the following: first cost of the car; capacity of the car (cubic contents and car weight); average load carried in tons; conditions which militate against full load; cost of maintenance; extra cost of hauling additional dead weight when moved with less than full capacity, and extra cost for maintenance of permanent way, bridges, etc.

A fair comparison can be obtained only by actual experience with a large capacity car under operating conditions, and it should be borne in mind that such only tends to show the value of the car in the particular territory where it is in service and where the comparisons are being made. Therefore, it would be interesting and valuable if a complete report could be had of the results

*Abstract of paper presented before the Railroad Division, December 7, 1926, at the annual meeting of the American Society of Mechanical Engineers.

obtained by the use of a given number of 50-ton cars in comparison with others. This report should cover a period of two or three years, furnishing the exact figures and facts, so that others who are contemplating the addition of new and heavier equipment may be better able to reach a correct conclusion as to the type of car best adapted for the locality through which their lines may run.

Some observations of a general character may serve to emphasize certain points of more or less interest. The Union Pacific and Southern Pacific, have in service thousands of 50-ton cars, and have had cars of this capacity in service for more than 20 years. Such equipment, as a rule, is loaded to a point reasonably near its capacity, for the entire haul over the owner's lines. This, of course, is an unusually favorable condition of service for the 50-ton cars and gives them the place at once among the improved facilities that count for increased net earnings. As further evidence of this, an enumeration of some of the various commodities handled at different points on the line and the quantity in percentage of the car capacity which enter into the general average attained are as follows:

Commodity	Car capacity, per cent
Wheat	107.1
Corn	81.7
Barley	85.1
Other grain	100.4
Ore and bullion	114.6
Coal (largely in box cars)	84.0
Coal (open top cars)	106.0
Gravel	109.0
Beets	101.4

Fifty-ton car has economic limitations

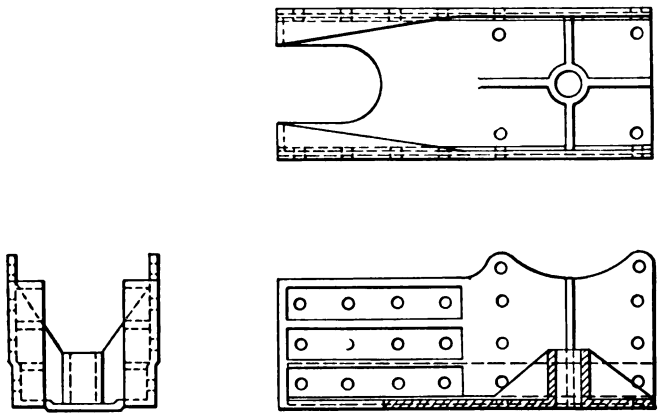
This also affords an excellent insight into the contention made by many that there is a special field for the 40-ton car, which the 50-ton car cannot invade without a positive loss, either direct or indirect, to the operating companies. Their field is the one where such commodities as hay, merchandise, mill stuff and miscellaneous products predominate and where conditions necessitate their movement in a manner to suit the shipper, regardless of the wish of the carrier. Furthermore, it is not within the range of possibilities for the carriers to educate their shippers so as to secure the delivery of their traffic of this character for movement at a time and in a manner that will permit a prompt and full car-load movement at a specified time. Ore, coal, grain and similar

Type of Car	Box Cars		Automobile Cars		Gondola Cars		Hopper Cars	
Capacity in Tons	40	50,55 & 60	40	50 & 55	50 & 55	70 & 75	50 & 55	70
Detail Data in Exhibits	1	2	3	4	5	6	7	8
No. of Cars Analysed	61,822	51,027	33,941	17,850	43,428	9,655	32,083	39,829
Kind of Center Sills, No. per cent								
Channel	65	79	23	75	85	28	100	100
Fish Belly	31	21	77	25	14	72	-	-
Wood	4	-	-	-	-	-	-	-
Misc.	-	-	-	-	-	-	-	-
Total, per cent	100	100	100	100	100	100	100	100
Kind of Trucks, No. per cent								
Arch Bar	16	16	10	-	8	-	27.3	-
Cast Steel	75	82	90	87	90	100	62.4	100
Pressed Steel	4	-	-	2	.5	-	1.0	-
Misc.	5	2	-	11	1.5	-	9.3	-
Total, per cent	100	100	100	100	100	100	100	100
Kind of Wheels, No. per cent								
Cast Iron	99	99.5	100	88	7.4	-	78.4	1.0
Steel	1	.5	-	-	91.0	100	12.3	94.4
Misc.	-	-	-	12	1.6	-	9.3	4.6
Total, per cent	100	100	100	100	100	100	100	100
Width of Side Doors, No. per cent								
5 ft. 0 in.	1.8	-	-	-	-	-	-	-
5 ft. $5\frac{1}{2}$ in.	1.3	-	-	-	-	-	-	-
5 ft. 6 in.	7.0	-	-	-	-	-	-	-
5 ft. 11 in.	2.4	-	-	-	-	-	-	-
6 ft. 0 in.	83.6	86.0	-	-	-	-	-	-
6 ft. 2 in.	-	14.0	-	-	-	-	-	-
7 ft. 0 in.	2.2	-	-	-	-	-	-	-
7 ft. 6 in.	-	-	-	-	-	-	-	-
9 ft. $8\frac{1}{2}$ in.	-	-	-	2.8	-	-	-	-
9 ft. $9\frac{3}{4}$ in.	-	-	-	5.8	-	-	-	-
10 ft. 0 in.	1.7	-	81.0	80.2	-	-	-	-
10 ft. 3/8 in.	-	-	4.0	-	-	-	-	-
10 ft. 1 7/16 in.	-	-	-	1.2	-	-	-	-
10 ft. $1\frac{3}{4}$ in.	-	-	2.0	-	-	-	-	-
10 ft. 2 in.	-	-	-	1.5	-	-	-	-
10 ft. 3 3/8 in.	-	-	2.0	-	-	-	-	-
10 ft. $5\frac{3}{4}$ in.	-	-	5.0	2.7	-	-	-	-
10 ft. 6 in.	-	-	3.0	5.8	-	-	-	-
None	-	-	-	-	100	100	100	100
Total, per cent	100	100	100	100	100	100	100	100
Size of End Door, No. per cent								
23 3/8 in. wide by 28 in. high	-	8	-	-	-	-	-	-
None	100	92	100	100	100	100	100	100
Total, per cent	100	100	100	100	100	100	100	100
Style of Construction, No. per cent	-							
All Steel	-	-	-	-	42.5	82.0	83.9	100
S.U. & S.F.	-	-	-	-	14.5	2.0	9.5	-
Steel Frame	-	-	-	-	17.0	13.0	-	-
S.U. & S.S.	-	-	-	-	1.0	2.0	-	-
Steel Und.	-	-	-	-	25.0	-	3.8	-
Steel Center Sill	-	-	-	-	-	-	.3	-
Comp. S.F.& S.S.	-	-	-	-	-	-	2.5	-
Total, per cent	-	-	-	-	100	100	100	100

Table showing the trend in construction of box, automobile, gondola and hopper cars

commodities, are regulated by the train load rather than by the car load and are offered for shipment at a time and in such quantities as not to require movements of less than the maximum train load.

The freight car mileage for 1925 was 26,729,831,000 miles; of this, 35 per cent was empty car mileage, which would indicate that there were many lines operated under a condition where it was almost impossible to secure loading in both directions for their cars. While this is doubtless largely the case with roads that are essentially coal or ore lines, yet much of it is in the agricultural districts where the empty mileage is box car equipment, handling an average of about 24 tons per loaded revenue car. This would seem to warrant the suggestion, if not the conclusion, that a general utility car substantially built to meet all the physical conditions resulting from interchange service, with minimum dimensions of the American Railway Association's standard box car, of a capacity not exceeding 80,000 lb. is, from some points of view, more desirable commercially, physically and financially, as a common standard for American railroads than the 50-ton car. The latter, however, has been adopted on some of the most important trunk lines and



Rear draft lug and bolster center casting

by virtue of the interchange arrangements between various roads forms no small percentage of the cars on the line which would otherwise favor 80,000 lb. capacity equipment.

It seems rather inconsistent, from a business and commercial standpoint, that large trunk lines should spend enormous sums of money in perfecting their permanent way, and other facilities for handling their business, and equally large sums in the purchase of motive power and equipment which is peculiarly adapted to their line and then a large portion of this equipment be diverted into a class of traffic and on to lines where the conditions are at considerable variance with those which hold directly opposite views as to its commercial value. While much of this modern, heavy equipment is found on roads whose officers question its adaptability to the conditions which they have to meet, a no less conspicuous feature of what might be termed unbusinesslike conditions, is the presence on the large trunk lines of a great number of small, antiquated cars belonging to the lines which do not favor the use of the large car. Many of these small cars were built years ago when the tractive force of our freight locomotives averaged about 35,000 lb. and the original construction of the cars was light. This, together with their age, renders their physical condition such that in some cases they are scarcely safe for service in light trains on local runs and are absolutely dangerous when placed in modern heavy trains handled by large types of heavy freight locomotives. Such a condition is dangerous not only to the cars themselves, but in case of accident, they are not only badly damaged, as a rule, but are the direct or indirect cause of destruction to the modern heavier cars with which they are intermixed in train service. The high cost of repairs to freight cars on some lines can be traced to the retention in service, in some cases, of light antiquated equipment that should have been retired from service immediately following the advent of modern car construction.

The more highly developed a railroad becomes in providing fast passenger service and regular freight service, the greater is the necessity for the use of good materials to prevent accidents and provide reliability of movement. When such services are offered to the public, there is imposed a moral responsibility to furnish materials which shall be equal to the service requirements.

Generally, coal cars returning empty to mines make substantially the same number of empty miles as is made on the loaded haul. There should be a decided saving in operation where larger cars are used. Furthermore, if there is a continued shortage of coal cars at mines in competitive territory during peak business, there would be a further gain in net revenue as a net result of whatever percentage of increased load obtained. Assuming the net earnings per day over and above all cost to handle, is one dollar on a smaller car, then with a larger car representing a 25 per cent increase in carrying capacity, this net would be increased to more than $1.25 a day (cost does not vary directly with capacity and the net saving will be more). If the car requires ten days to make the round trip, the increased revenue would, at least, be more than $2.50 for the round trip and would probably result in a substantial net return from the additional net revenue on the additional investment required for the larger cars, providing the peak movement under these circumstances existed during 40 per cent of the yearly period.

Cars should be designed for the service for which they are intended

In designing a car, what must be considered is the service in which it is going to run, not the service in which it may run.

One of the advantages given for all steel, steel underframe and steel frame cars, is that train resistance is less than with wooden cars. The principal reasons for expecting a lower resistance with a steel car are: first, on account of its greater rigidity there is less deflection in the bolsters and the side bearings are not in contact under the maximum load, hence, there is less flange friction and a lower tractive resistance; second, the capacity of steel cars is so much greater than that of wooden cars that it is possible to haul the same tonnage in one-half or two-thirds the number of cars, and it has been found that the increase in train resistance for a given total tonnage increases with the number of cars required to equal that given tonnage. This is to be expected from the greater area exposed to atmospheric resistance and because of the large number of wheels producing flange friction. With equal coupler clearance on straight track, there should be no difference in the resistance of the wooden and steel cars, so far as the drawbars are concerned. On the curves, however, the rigidity of the steel draft rigging prevents the coupler from accommodating itself on the normal line of the pull, and if the clearance is too small the wheel flanges are forced against the rail, thus increasing the train resistance. With the wooden car, however, the draft timbers are easily displaced or compressed and the bolts in the wooden draft attachment work to one side and the whole rigging gives enough to

provide a movement of the coupler equivalent to greater clearance and sufficient to prevent undue flange friction.

The foundation of economic efficiency in freight train service is the utilization of each car to its fullest capacity, and the first step in this direction must be taken at the origin of the traffic. The latter points, for the most part, when considered west of Chicago, are in isolated sections, not lending themselves easily to intensified supervision. It is essential that cars be in proper condition with respect to wheels and air brakes before loading because far too many refrigerator and oil tank cars are unnecessarily delayed under load for wheel changes, and for defects which should have been discovered and corrected at the last repair point before loading.

Freight cars are used in common under the A. R. A. car service rules, the per diem agreement and the interchange agreement. They are repaired (with certain exceptions) on the road where the need for the repairs develops. The average freight car of an individual road is at home not much more than one-half of the time. Obviously, if there is a common standard for the types of car used for the great bulk of the interchanged traffic, each road will be required to carry a much smaller stock of repair parts, and there will be a reduction in the time now lost by cars which are held while the repairing road is obtaining parts of special design.

Dependable cars have always been regarded as the most vital requirement upon car department executives. The consequences of the failure on the road are such that in car construction and subsequent maintenance, operating reliability is the first consideration. No feature in design, however efficient, and no maintenance practice, however economical, will ever be tolerated on our railroads, if it impairs the ability of the car to function successfully in regular train service. No saving in the cost of operating car shops and terminals will justify car failures resulting from too rigid economy in their maintenance. Nor can the time that cars are available for service be increased at the expense of the time actually required for maintaining these cars in a dependable operating condition. Next to reliability in train operation comes the efficiency of design with respect to weight, cost and structural stability.

Increase in empty car miles indicates better performance

Net tons per car load seems to remain stationary in the face of improvement in practically all other factors such as net tons a car day, car miles a car day, freight locomotive miles per locomotive day, freight cars per train, gross tons and net tons per train and average speed of freight trains. Empty car miles seem to increase by reason of better performance on the part of carriers. This situation indicates that where an improvement in other directions obtains, a decided increase in the percentage of empty mileage will result, and the sole reason for having an increase in the percentage of empty mileage comes from the fact that administrations are at present moving empties promptly, whereas when they had a low percentage of empty mileage the empties were standing still and there was a shortage of cars. It is felt by the best authorities that as long as we continue to make an improvement in the movement of business we are going to show an increase in the percentage of empty mileage compared with periods when the movement was not so prompt.

The argument is often made in favor of an all-service car for various combinations of traffic. It can be said that there is no such thing in existence as a common service box car, because the only way this could be provided would be to maintain all box cars at all times fit for the handling of the highest class traffic that moves, regardless of the fact that they may be used for that traffic only a small percentage of the time. Many administrations find it economical and proper to confine new and rebuilt box cars to the higher class traffic and not permit them to get into the moving of stone, brick, tile, cement, lime, tar and a lot of other commodities that make a car unfit for high class traffic. In the case of cars used for automobile loading, it only necessitates a few trips to make such equipment unfit for flour, sugar and other high class loading, for the simple reason that the floors are stained with oil, cars are filled with nails, spikes, cleats, etc.

The problem of unproductive weight

To whatever extent the unproductive weight of the train can be diminished, to that extent the productive weight may be increased. It is, therefore, an element of efficient use of tractive force, from a business point of view, that the dead-weight proportion of a train shall be maintained at the lowest point consistent with reliability in performance. If we were to consider the cost of hauling 800 lb. avoidable weight per car, because of using a certain feature of design instead of another of equal engineering value, and in order to save the extra weight it was necessary to pay $60 extra per car in first cost of the car, and the maintenance features were not affected, the problem would work out as follows:

Average miles per car owned per day........................ (Includes bad orders)	28.3 miles
Cost of hauling one ton of dead weight one mile by Class I railroads varies largely from $0.004 to $0.007, so that by using the mean figure, it should be considered....................	$0.0055
Considering 6 per cent bad order cars, would mean 94 per cent of 365 days in service, or..................................	343 days

Therefore $\frac{800}{2000} \times 343 \times 28.3 \times 0.0055 = \$21.36$ per year,

or $\frac{60}{21.36} = 2.75$ years to pay.

It should be understood that any figure used, such as $21.36, is more or less theoretical since the cost of hauling per ton of weight is not directly proportional to the weight carried but rather the relation of full tonnage possibilities to actual tonnage hauled. A carrier having full tonnage trains will have a lower cost per ton mile than one with variable loads of less than full tonnage.

Methods of load distribution used by the designer

Notwithstanding the claims made as to the indestructability of steel cars, the question of normal deterioration and attention required for equipment encountering yard and wreck damage and unfair usage is still a very important design consideration, in conjunction with the problem of repairs and methods and facilities needed economically to dispose of the work. Considerations of strength need to be constantly reviewed, because of changing operating characteristics of service required from freight cars.

The proportioning of the longitudinal sills in the underframe for vertical load and end shocks is an important question in freight car design. In the past there has been a wide difference of opinion as to the proper distribution of weight to each individual member, but the Car Construction Committee of the American Railway Association has made some exhaustive studies and cleared up this question, in an endeavor to lead to a sound understanding.

In rare cases, for example, in designing flat cars, concentrated load in the center of car must be considered. The present American Railway Association requirement for this class of equipment is severe and an exceptionally heavy structure is required to meet the situation. The

ballast car and coal hopper car also present a special problem as to load distribution, but in other types of freight cars a uniformly distributed load can safely be assumed, provided that the design is based upon maximum loading conditions.

It is also an open question as to how sills should be proportioned in relation to each other; that is, as to whether the center sills should carry all of the load, or whether the side and center should each carry their portion. Also in the case of cars requiring sides for containing the lading, whether these sides should act as a girder and carry the greater portion of the load. In the case of flat cars, for instance, a common method employed is to design them with deep center sills, proportioned to carry most of the load, with rolled section for side sills, figured as a continuous beam supported at the bolsters and cross bearers, and carrying a small portion of the load distributed along the sides of the car. Other administrations figure that the side sills should be made sufficiently strong to carry their portion of the load, thus necessitating fish-belly sills throughout. Such a requirement, while not universal, is sufficiently evident in normal interchange of cars designed to haul machinery, blocks of stone, tractors, etc., to make it a problem requiring thought and study at times when selection in design is made.

For steel gondolas and such cars as require sides for containing lading, and which usually consist of a web plate with top and bottom flange members, it is, of course, the most economical construction to figure them as complete girders, and so proportioned to carry the greater portion of the load, keeping in mind the necessity of providing for lateral stiffeners to prevent bulging and the collapse of the girder. The carrying of the load on the side construction, because of its depth, makes an economical girder and usually works out the cheapest, but of course would not apply to house car equipment fitted with wooden superstructure. In this case the framing should not be depended upon to carry the load, on account of insufficient strength of wooden connections, framing becoming loose on account of wood drying out and tie rods imbedding themselves into the framework, or otherwise losing their tension. It would apply, however, where the steel side sill at the bottom and the steel side plate construction at the top, form an open truss between the bolsters. In proportioning the side framing to carry a portion of the vertical load, account should be taken of the bulging pressures encountered in service under certain conditions of lading.

The draft gear and underframe

Sufficient consideration is often not given to the problems involved in providing and maintaining a suitable draft gear at the back of the coupler. Impact blows must be absorbed in some manner. These should be taken by the draft gear, and gradually and equally transmitted to the component parts of the underframe, delaying the full effect of the blow until it can be partially dissipated by the movement of the car. With the rapid disappearance of wooden cars a great amount of train flexibility by reason of the resilience of the wooden underframing, has been lost. The splicing of the center sills in front of the bolster and the use of separate draft sills to facilitate repairs was until recent years a detail which has been the source of many arguments. With the use of combination rear draft lug and bolster center casting there is no reason left for employing separate draft sills.

In common with the practice followed by the American Railway Association, the Chicago, Milwaukee & St. Paul employs combination rear draft lug and bolster center casting as shown in one of the drawings. Such construction makes it possible to deliver a maximum buffing shock with the least destruction to the car, principally because of the possibility of proper distribution to the center sills, bolster and other longitudinal members of the car. Latest practice calls for integral center sill construction from end to end of the car, some administrations using 5 ft. distance between the center line of the bolster and the face of the striking casting, in order to minimize the swing of the coupler on sharp curves and permit of shortest possible over-all length in the case of hopper cars. Others prefer a 5 ft. 6 in. distance in order to provide ideal application of the side sill step and prevent it from interfering with the opening of the journal box lid when the sill step is placed centrally under the side ladder; also to take advantage of the reduction of stresses in the car structure which is possible by reason of greater overhang on the ends of the car.

The proportioning of the bolsters depends, of course, to a large extent as to how the vertical load is distributed and carried by the longitudinal members, thereby determining how much load is to be transmitted to the center plate through the bolster. The need for taking into account the raising of the car while under load when jacks are used at the extreme end of the body bolsters, should not be overlooked. One of the most important details in bolster construction is the center filler between the center sills, shown in the drawing, located directly over the center plate. This detail must be designed to protect against fracturing the center plate and the possible tearing or bending of the bolster cover plate, thus allowing the side bearing clearance to be taken up, resulting in derailments of cars.

The improvement of couplers, draft gear and attachments promoting speedier and safer connecting and disconnecting of cars, as well as in securing them more firmly while in train service, has been accompanied by an even more remarkable development in brake apparatus for arresting the motion of the cars, either singly or in trains. Draft gears and brakes need to be systematically maintained and known to be in good operating condition, with complete stencilled identification on each car showing the date and place of last inspection and repair. While this is a mandatory practice with respect to airbrakes, it has not, as yet, been extended to the draft gears, except by individual roads. Wherever it has been practiced, the operation of the cars, their maintenance, and condition of lading carried have shown marked improvement. End construction has been particularly benefited in such cases.

Center of gravity is too high in some types of cars

Another feature, respecting freight car design, which is often not sufficiently considered, has regard to the permissible center of gravity of cars under load. Experience has shown that 6½ ft. from the top of the rail is about all that is safe for ordinary service, and, yet, many of the large sized hopper, automobile and furniture cars are operating under load with centers of gravity in excess of 7 ft. This is the main reason why so many derailments and wrecks occur with cars 10 ft. high inside and loaded to the roof. Strictest care is necessary in train handling and track maintenance on curves in order to minimize that element of danger.

The diagonal brace, which is usually placed in all underframes at the corners, is a detail which varies according to the ideas of the designer. Some advocate extending it from the ends of the center sill to the intersection of the side sill and bolster. Others prefers to have the brace extended from the corner to the center sill at the bolster. The former arrangement relieves the center

sill of a portion of the buffing shocks, transmitting them to the sides; also any cornering of the car sufficient to damage it to a considerable extent would be great enough to damage the brace if it extended from the corner of the car to the intersection of the center sill and bolster. Without the brace at the corner, the underframe is more easily repaired. However, on cars where push pole pockets are used to a large extent, it is quite important that the brace be provided in the latter location to transmit the thrust to the center sill. The employment of roping staples located at or near the bolster has largely done away with push poles and more cars are being pulled instead of pushed in spotting them; this is particularly true at mines, logging camps or industrial tracks.

Much difficulty is being experienced at this time, with truck coil-springs under 50 and 70-ton capacity cars, on account of existing designs going solid under load and causing breakage. A freight car truck spring has necessarily to work through a tremendous range of carrying capacity, namely, that of the light weight of the car body as a minimum, and this weight plus the full carrying capacity of the car, which is generally equal to five or six times the light weight, as a maximum. While space restrictions are significant with the conventional design of truck, the provision of a safe spring, namely, one that will allow (1) the car to remain on the track and (2) not permit the load to punish the track unnecessarily, are important considerations. Some roads are resorting to the addition of springs in order to give greater cushioning capacity, others are employing improved material and still others are modifying the shape of the bar forming the coils in order to attain greater capacity and more travel. The bar of steel forming the spring should not be any larger than absolutely necessary in order to allow of proper heat treatment. It is quite possible that with the increase in freight train speeds being demanded at this time, new designs of trucks will be required to provide greater safety, and certainly to relieve the truck springs of the tremendous side thrust action they are now subject to. Lastly railroad spring shop practice may be largely benefited from a study and application of methods employed in the automobile industry.

The introduction of all steel or steel frame cars began when the first of the modern steel cars were built about 1897, yet we have record of steel cars having been built, to a limited extent, as far back as 1853, and in much larger numbers a few years later in Europe. The Eastern Railway of France alone in 1905 had over 20,000 cars with metal framing or all metal construction in service. Taking the year 1907 as a base and one of the normal operation in the car building industry, the returns from 367 car building concerns indicate 284,188 freight cars built, of which 72 per cent were of all steel or steel underframe construction. The proportion of steel cars to wooden cars built emphasizes the rapidity with which the introduction of metal into freight train cars took place, from this period on.

One of the tables shows the percentages of a total of 289,637 cars built by six of the leading car building companies in the country over a period 1921 to 1926 inclusive, having different features of construction. This table includes 40, 50, 55 and 60-ton box cars; 40, 50 and 55-ton automobile cars; 50, 55, 70 and 75-ton gondola cars, and 50, 55 and 70-ton hopper cars.

Of the number of cars shown, 31.8 per cent are of all steel construction; 15.3 per cent are of steel framed construction with wooden lining; 52.9 per cent with steel underframe and double sheathed wooden superstructure; 100 per cent with steel center sills. So far as trucks are concerned, 89.2 per cent are equipped with cast steel trucks and 10.8 per cent with other than cast steel trucks; also 81.2 per cent are fitted with cast iron wheels and 18.8 per cent with steel wheels. The average light weight of all cars per cubic foot carrying capacity was 19.85 lb., ranging from a minimum of 12.24 lb. to a maximum of 34.27 lb.

Standardization of castings and forgings

The designing of the modern all-steel and steel framed car up to the year 1912, was left largely to the car builder, in conjunction with, and often under the supervision of railway mechanical officers. This was because of the fact that this type of construction was at that time quite new and it was necessary for the manufacturers to design and present the many advantages to be gained in substituting steel for wood in car construction. This period was followed by the larger systems taking up the designing of their steel car equipment on quite an extensive scale. They consequently not only furnished builders with complete specifications covering the construction of the car, but also an engineering analysis of all parts and detailed drawings, including bills of material.

Both arrangements have their advantages and disadvantages. In the case of a railroad designing its own cars, it is possible to standardize its castings, forgings, and miscellaneous parts to a considerable extent, and, by keeping in mind its standard cars of different classes, it is often able to design them in such a manner as to have several parts common to all classes, thereby assisting to reduce the investment for repair parts, as well as making substitutions conveniently. This, however, often works out to the disadvantage of the car builder, as he, too, has standard patterns, etc., which, of course, are to his advantage to employ. These standards may differ from the railroad company's standard just enough to necessitate new dies and patterns to such an extent that the saving gained in having the drawings, specifications and bills of material furnished is more than offset by die and pattern expense. These dies may never be employed on later orders, which means, of course, that the entire die and pattern cost must be borne by this particular order of cars.

In the case of large orders this cost, distributed over the entire lot, would not represent as important a charge per car as in the case of a smaller order, but it is a serious factor to be taken into consideration in estimating and designing. The number of complicated shapes should, therefore, be kept as low as possible. It is essential that a maximum standardization of all castings and such forgings as might be termed running repair parts, such as brake gear, draft gear, safety appliances, etc., should be standardized as far as possible, in order to attain economical manufacturing shop practice and road running repair maintenance. The need for standard construction,' where practicable, should be emphasized constantly.

While the American Railway Association has accomplished admirable results in the way of standardizing car designs, truck parts, draft gear parts, etc., this endeavor cannot be made successful unless taken seriously by the various large administrations in the purchase of new equipment.

The question of limiting stresses to be used in the design of cars needs to be thoroughly understood and carefully applied. The following is offered as a recommendation and is based upon exhaustive studies made with respect to A. R. A. standard car designs now being developed to a conclusion:

1—Unit stresses.
Structural steel:

Tension .... 16,000 lb. per sq. in.
Compression for columns whose ratio of length to least radius of gyration is less than 40.... 16,000 lb. per sq. in.
For columns whose ratio of length to least radius of gyration exceeds 40, determine the maximum unit compressive stress at the center of the column due to a direct load by means of the Rankine formula, fixed ends, transposed as follows: $S = \frac{PC}{A}$

where
S = Maximum unit stress in lb. per sq. in. in a long column due to a direct load.
P = Direct compressive stress in lb.
A = Area of section in sq. in.

$$C = 1 + \frac{1}{25,000}\frac{(L)^2}{(r)}$$

L = Length of column in inches.
r = Least radius of gyration in inches.

For ends of columns, where the bending movement due to slenderness ratio is neglected.... 16,000 lb. per sq. in.
Shear .... 12,800 lb. per sq. in.

Rivets:
Shear .... 10,000 lb. per sq. in.
Bearing .... 20,000 lb. per sq. in.

Wood:
Tension .... 600 lb. per sq. in.

2—The car body should be designed to carry under service conditions the maximum rail load limit prescribed.
3—Center sills should be designed to withstand
a—An end load of 250,000 lb. per sq. in. applied on the back stop at the center line of the draft.
b—Weight of center sill and attachments.
c—Vertical load reactions of floor planks.
4—Bolsters and crossbearers should be designed to carry
a—Total reactions from the side sill for the bolster, and center sills for the crossbearer.
b—Weight of the bolster or crossbearer attachments.
Only the cover plates of bolsters and crossbearers should be considered as effective in resisting bending moment.
5—All connections should be designed for the maximum load to which the member connected may be subject and so detailed as to eliminate insofar as possible eccentricity effects within the members. Where it is not possible to eliminate secondary stresses in any members caused by eccentric loads these should be combined with the direct stresses in such members.

Conclusions

Railroads should systematically consider the current requirements of the service as they become increasingly apparent from year to year in view of enlargement in traffic and the ever changing conditions of operation.

Maintenance policies need to be formulated far in advance, in order to maintain currently and turn over a proper number of cars by classes, and to employ the least complement of facilities and labor force regularly to keep the entire plant structure working efficiently and uniformly to the greatest reasonable degree and, yet, with a maximum economical output.

Railroads should adhere to a 20 to 25 year life for freight train cars with an annual depreciation rate to coincide with whatever figure is used and provide for suitable and current replacement.

Railroads should procure freight train cars when built new embodying the design fundamentals recommended by the A. R. A. and of minimum weight consistent with traffic and engineering considerations.

Railroads should give constant thought to the fact that freight train cars should be built interchangeably between roads insofar as possible in order to lessen first cost and improve current maintenance when cars are off the line and also to avoid delay when needing repairs which may be occasioned when special repair material is needed.

Special classes of cars should not be built unless they are really justified from the standpoint of actual traffic and operating experience factors.

Interchange Inspectors' discussion of new rules

Differences of opinion were expressed over the meaning of Rules 2, 17, 36, 66 and 75

In addition to the presentation of papers, abstracts of some of which have been published in the two preceding issues of the *Railway Mechanical Engineer*, the last two sessions of the Chief Interchange Car Inspectors' and Car Foremen's Association convention, held at Chicago, September 21 to 23, were devoted principally to the discussion of the new interchange rules. The discussion is abstracted in this issue.

Discussion of freight car rules

Rule 2

New form—(f) *Transfer authority will not be issued on account of the following defects (Included in new paragraph 1 and 2)*:

1—All truck defects on home care.

2—All truck defects on foreign cars; except *defective* metal bolsters or center plates cast integral therewith, *defective* truck sides and transoms, defective non-A. R. A. standard journal boxes where the A. R. A. standard is not a proper substitute.

3—Defective outside *wood* end sills, all cars.

4—Defective body center plates where not cast integral with bolster, all cars.

5—Defective *or missing* body center plate bolts *or rivets, whether or not they pass through center sills*, all cars.

6—Defective *or missing* center pins.

7—Renewal of any *or all* roof boards on outside *wood* roofs and inside metal roofs, where purlines, *carlines*, ridge pole and plates are in good condition, all cars.

8—Defective or missing side doors, end doors, roof doors and hatch covers, all cars.

9—*Any other defects which can be repaired under load, or if car is safe to run and safe for lading, the receiving line to be the judge. Note: The word "Defective," as used in the foregoing, is intended to mean that the part or parts referred to are defective to the extent that, in the judgment of the receiving line, immediate repairs or renewal are necessary.*

(g) A. R. A. car service Rule 14 will apply when transfer or rearrangement of lading is necessary, including application of proper door protection as required by the loading rules.

Reason—To facilitate the movement of cars through interchange and avoid unnecessary transfers.

M. E. Fitzgerald (C. & E. I.): Is this the rule proposed or is it the change which has been approved by the A. R. A. Committee?

T. W. Trapnell (C. I. I., Kansas City, Mo.): They are approved and will be effective January 1, 1927.

T. J. O'Donnell (Buffalo, N. Y.): Note 9 of Rule 2, is entirely new and the latter part of it says "that in the judgment of the receiving line immediate repairs or renewal are necessary."

J. J. Gainey (Southern): The rule states that the receiving line will be the judge. A few lines further up it states that the receiving line will be the judge as

long as there is no chief interchange inspector there to judge.

Mr. O'Donnell: I would like to ask Mr. Gainey if he is giving away any Southern money by making transfers where transfers are not necessary.

Mr. Gainey: I still say that the receiving line is the judge as to whether the car is safe to run over that railroad or not. If he is arbitrary and says the car is not safe to go he has the right to transfer it and I have to pay the cost of transferring.

President Elliott: I remember in discussing the question one of the chief interchange inspectors said the car was not safe to run and the receiving line would not run it and I think that is what the Arbitration Committee had in mind.

Mr. Fitzgerald: We will not have any great amount of trouble at points where chief joint inspectors are located. They know the regulations covering these things and they would say that if the receiving line decides not to run the car they should transfer it at outside points at their own expense. This rule still leaves the question up to the receiving line and it is their decision whether or not they want to run the car. There is nothing in the rule which tells you to make certain repairs. It is a question of studying the rule and we will not have any trouble.

Mr. O'Donnell: I disagree with Mr. Fitzgerald. I interpret the Arbitration Committee's decision that the cost of transferring is against the delivering line, but there are defects that will not permit the reloading of cars. I maintain that we should take away from the receiving line some of the feeling that it can do as it pleases.

W. R. Rogers (C. I. I., Youngstown, Ohio): It seems to me that the Arbitration Committee expects us to use a little ordinary good judgment in regard to this question. The receiving road is still the judge as to what defects will be repaired under load or run, but it is the intention to repair reasonable defects.

C. J. Nelson (C. I. I., Chicago): It is my impression that the rules of interchange referring to the transferring of cars is intended to only serve as a guide. It would be absolutely impossible for the Arbitration Committee or any other committee to build up a set of rules that would indicate to the man in the field the kind of defects for which a car could be transferred, so it seems to resolve itself into a question of exercising the best possible judgment. The rule is plain enough in designating to each the authority to say whether or not that car can be handled over the receiving line's rails. There is no question but what the receiving line has the right to decide whether or not transfer is to be made.

Mr. O'Donnell: I make a motion that it is the sense of this body that Article 9 of Rule 2 intends to convey to all interchange points that the lading of the car must not be disturbed unless the car is absolutely unfit for further handling of the load it carries.

The motion was lost.

Mr. Trapnell: I do not believe this body has a right to approve an interpretation of an A. R. A. Rule. I move that we as Chief Interchange Inspectors understand the rule as published in this book to facilitate the movement of the car, that rule will go into effect the first day of January, 1927.

The motion was lost.

Rule 4

New form—In the case of damage to a car by unfair usage, the handling line must, at the first available inspection point, attach defect card to cover. If the car is in shop and a portion only of the unfair usage damage is repaired, defect card must be applied before car leaves the shop. If a car is offered in interchange with delivering line defects, the receiving line shall require that a defect card be securely attached to the car, as per Rule 14.

Reason—It is felt this requirement will improve the situation at interchange points.

M. P. Williams (Michigan Central): Many of you who have had to do with the education of inspectors and repair track supervisors should try to educate them along the lines of this rule If the car is damaged on our line we can put a defect card on it rather than see it get by interchange points when we do not put a defect card on the car at the time the damage is done. The car passes one or two interchange points and the next chief interchange inspector is alert and catches it. That places the burden on another line, which is wrong. What we should do is to go into this wholeheartedly and tell our men we want to protect the owner on all the damage we do. If you have a car side-swiped and you do not want to repair it then, at least explain it by putting your defect card on it. Do not take a chance on putting it on at the next interchange point.

Rule 7

New form—All items carrying labor charges must be covered in proper detail on the original record; the time or money charges (as per Rule 107 and 111) need not be shown. For items of labor computed on the rivet basis, the number and diameter of rivets, *and purpose for which used,* must be shown on original record. For items of labor for straightening or repairing, computed upon weight basis, the weight of material must be shown on original record.

Reason—To enable the car owner properly to check repair bills.

John J. Whelan (B. & O.): The proposed change will work a hardship on the billing clerk in place of the car owner and will make additional work in his office in checking the foreign bills. You will have to check seven or eight steel repair shops and the clerk billing out the work will have to make a great many multiplications. When you only multiply once you can go over it once to avoid an error. I do not see how it will help the carmen because they do not have time to count the number of rivets they used in a car. When the owner receives the bill for the defects on a steel car he can estimate whether or not that bill is proper. If the bill is exorbitant he can take exception to it and return it to the repairing line.

Secretary Sternberg: I am somewhat surprised at Mr. Whelan. We have to check against the tank car people and they do not tell us where they put the rivets. I think this will clarify the rule and you will have less work answering exceptions taken to bills than in writing extra repair cards.

T. S. Cheadle (R. F. & P.): If I have seven or eight rivets in a center plate, and seven or eight more in a coupler stop what will I do?

Secretary Sternberg: Designate them.

Rule 17

New form—If the car owner elects, on account of improper repairs, to remove an A. R. A. standard coupler, A. R. A. type D coupler or A. R. A. Temporary Standard coupler in good condition, secondhand credit should be allowed, *and charge for coupler confined to secondhand value.*

Reason—To clarify the intent of the rule.

Mr. Rogers: Does the A. R. A. standard and recommended practice show a standard coupler other than "D" type? If not is the A. R. A. standard coupler referred to the former standard coupler? If so, why don't they all say former standard coupler?

Henry Andrews (N. Y. C.): It occurs to me that during 1911 when the safety law first went into effect, we had to have certain end line clearance, it was permissible to apply a 12½-in. head coupler which afforded a 10-in clearance. It is my understanding that is what is meant by this interpretation. We should have the A. R. A. 9¼-in. head and the 10¼-in. head and the A. R. A. knuckle.

V. R. Hawthorne (Secretary, Mechanical Division, A. R. A.): Mr. Rogers' question is well taken; the rule should say "former." The committee is revising the rules and will take care of that.

Mr. Fitzgerald: What I cannot understand in this proposed rule is why, assuming that a railroad applies a type "D" coupler and we own the car, a bill is rendered against us and we pay for that particular coupler. It belongs to us and if the car comes back and we take that coupler out why should we give the road any credit for it?

W. J. Owen (P. & P. U.): As I understand it, that rule refers only to wrong repairs, for instance, you put a 6-in by 8-in. coupler in place of a 5-in. by 7-in. or a 5-in. by 7-in. in place of a 6-in. by 8-in., or a 5-in. by 7-in. in place of a 5-in. by 5-in., that would be wrong repairs.

Mr. Fitzgerald: Very few roads are making wrong repairs without billing. I am going to assume that you repair a car and put in a wrong coupler, when I take that coupler out I have already paid for it and when I repair the car I am entitled to bill for the repairs, but I do not understand why after I have paid him for the coupler I should turn around and give him credit for it.

S. M. Martin (B. & O.): The rule says A. R. A. standard coupler type "D." The rule is written for the purpose of keeping roads from going back and applying the old standard again. It is an incentive to get to the new standard coupler.

Rule 32

New second paragraph—Combination outlet valve and plug missing from tank car where car is stencilled that it is so equipped.

Reason—It is felt that this item should be protected in interchange.

J. D. Ernst (Illinois Central): On this combination outlet valve and cap plug, should it not be outlet valve cap?

Mr. Hawthorne: That is correct and will be corrected in the rules this year.

Mr. Rogers: Will someone who actually knows, tell me just what this combination outlet valve and plug is?

Mr. Hawthorne: The committee will try to clarify that in the rules before they are printed.

Rule 36

New second paragraph, Section 3—Missing placards or certificates on cars containing explosives and other dangerous articles must be replaced. Placards, *commodity cards* and certificates on empty cars, except as provided in paragraph 1056 of the Interstate Commerce Commission Regulations, must be removed, etc.

New form of interpretation (2)—Q. Paragraph 3 states that inflammable cards, *commodity cards* and certificates on empty *tank* cars must me removed; may such cards be removed from empty cars and defect card issued against delivering line?

A. Yes, except optional empty tank car card as provided in paragraph 1056 of the Interstate Commerce Commission regulations.

Reason—To clarify the intent of the rule.

M. P. Williams (Michigan Central): The commodity card referred to in the second sentence is probably the same as that mentioned in the first sentence, but if a car loaded with gasoline is offered in interchange carrying placards, you say that such cars require a dome or commodity card.

The Chairman: The commodity card is about 6 in. by 8 in. and designates the shipper, the consignee, and tells what the car contains.

Mr. Williams: In other words, the commodity card does not refer to the gasoline card that is required to be placed on the side of the tank or on the running board.

Secretary Sternberg: I think the rule refers to all commodity cards.

James Harris (Mo. P.): This is not the regular form of commodity card, it is a little card marked gasoline, fuel oil, acid or whatever the car contains.

Mr. Williams: Do you call that the routing card?

Mr. Harris: The M. C. B. red book gives them as commodity cards.

Mr. Williams: That is my interpretation of the commodity card. I think that is something that should be ironed out here.

H. W. Bayliss (Pere Marquette): There is a kind of commodity card used on these tank cars which gives the point of shipment, loading and consignee, which is put in card containers and is the commodity card referred to.

Mr. Hawthorne: I think Mr. Williams is correct. It is the card which says gasoline or gas, oil, and these cards are being removed from cars. This question came up last year, raised by some of the oil shippers. It does not refer to the routing card that Mr. Elliott had in mind.

Secretary Sternberg: Any card that conveys information as to the contents of the car is a commodity card.

W. J. Owens (P. & P. U.): Rule 36 covers the commodity card in Section 2.

Mr. Williams: The first sentence of the proposed form does not mention commodity cards on cars containing explosives, but the second sentence states that placards, commodity cards and certificates on empty cars must be removed. If the word commodity card is also referred to in the first sentence, then that makes the road on whose line the car was loaded responsible for the car which was loaded. If you say take them off when the car is empty, why not say put them on when the car is loaded after they are received. The rule as now printed does not cover that. I think they should put in the words "Commodity Card" in the firse sentence.

Mr. Cheadle: As I understand it the rule requires you to take them off when car is empty, but does not require you to put them on the car when loaded.

Mr. O'Donnell: I do not think that is the intention. Commodity cards are considered on any class of equipment and I think the Arbitration Committee intended to provide for that by requiring these cards. It does not refer only to the Bureau of Explosives cards, you have them on other cars. That is the commodity card in the strict sense of the rule. Why shift to loaded cars when we are talking of about empty cars?

Secretary Sternberg: Is a commodity card considered an advertisement?

Mr. O'Donnell: No.

Secretary Sternberg: If it is not considered an advertisement there is no difference whether or not you remove it.

Mr. O'Donnell: This rule covers all cars, and is just as much applicable to box cars, or refrigerators or any other cars. The Arbitration Committee have rules that the commodity cards should be removed when the car is unloaded.

M. P. Cole (Belt Ry. of Chicago): It would appear

to me that the rule of the Arbitration Committee is well taken. There is no change recommended in Rule 36, items one or two, and my understanding is that the commodity card is permissible on all loads, the only change recommended applies to tank cars.

Rule 66

New form (owners responsible)—(a) *Periodic repacking of journal boxes, after the expiration of twelve months, as indicated by the stenciling on car, regardless of the responsibility of handling company for change of wheels or other repairs.*

(b) *All journal boxes shall be jacked; all journal wedges and bearings removed for examination, and renewed where necessary; all boxes cleaned and repacked with properly prepared packing (new or renovated) in accordance with A. R. A. recommended practice, and car stenciled. Dust guards shall be renewed, when necessary, only where wheels or journal boxes are changed.*

(c) The date and place (railroad and station) where *this* work is done *shall* be stenciled on car body near the body bolster at diagonal corners *with not less* than 1-in. figures and letters, using the same station initial *as* is used for airbrake stencil. *This provision also applies to new cars.*

(d) No change *shall* be made in the stenciling unless all boxes are repacked *and the work complete, in all details has been performed.*

(e) *If car bears no stenciling showing date of previous repacking, all boxes may, if necessary, be repacked in accordance with paragraphs* (b) *and* (c).

(f) *This work shall be done only when cars are on repair track for other repairs.*

(g) *No charge shall be made for repacking, etc., if performed within twelve months from date stenciled on car.*

(h) *No charge shall be made for repacking, etc., unless all boxes are repacked and the work complete, in all details, has been performed.*

(i) *Work performed, in accordance with the foregoing, to be charged to car owner at prices specified in Rule* 101.

(j) *Journal bearings having back or lug broken or cracked, or length reduced* ⅜ *in. or more, or lining loose, cracked, broken, spread over side or worn through to brass, shall be considered as requiring renewal.*

(k) *Journal bearing wedges, cracked, broken, or top radius worn flat lengthwise of wedge, shall be considered as requiring renewal. Care must be taken to see that wedges are not scrapped account worn unless top radius is actually worn flat.*

(l) *The periodic repacking, etc., does not contemplate any change in the ordinary attention as to oiling and packing when necessary.*

The A. R. A. Recommended Practice, as mentioned in paragraph (b), *is as follows:*

P. J. Hogan (N. Y. N. H. & H.): Is it necessary to state journal boxes jacked or repacked, showing the station, date and name of railroad?

Mr. Hawthorne: The statement in Rule 9 covers that.

B. F. Jamison (Southern): The stencil should show the length of journal, name of road and date of last previous repacking.

Mr. Hogan: The stencil is what I am after.

Mr. Hawthorne: The stencil is covered by a later pamphlet of the Committee of Car Construction on stenciling the letters on cars.

Mr. Hogan: If the top radius of the journal wedge is worn flat this flat wedge should be specified. A specific flat spot should be inserted in the instructions.

Mr. Hawthorne: In that connection I would say that the Committee on Car Construction has on its docket the matter of journal wedges and undoubtedly that committee will have something to report.

Mr. Cole: Referring to item *J*, I wonder if the gentlemen are aware that the journal bearing which they are now applying are all running short, in other words the journal bearings measure 7x¾ in. We have taken actual measurements on our line, as well as on others, and we find that these conditions exist. This is a matter for the Arbitration Committee to consider and also for the representatives of the various roads, which are here, to take home and perhaps help get after the manufacturer to give you the length of the brass you desire.

F. A. Ryan (N. Y. C.): Does Rule 66 apply to owners' cars. I had a discussion on that just recently and it was found that the car owner did not have to comply with the details outlined in Rule 66 in repacking his own car. It seems what would have to be done on foreign cars would have to be done on home cars.

The Chairman: As I understand it, the rule applies to home cars as well as foreign cars.

Mr. Williams: I would like to refer to section *F* of the proposed form, which states, "This work shall be done only when cars are on repair track for other repairs." There are a large number of bill clerks here, and this is one of the things we are going to have a lot of trouble on.

George Smith (C. & E. J.): The application or interpretation in Rule 60 would apply in Rule 66. In case of air brake, there is three months in which the work might be done if it is necessary to shop the car, while in Rule 66 the packing is out of date.

Mr. Williams: That is not what I meant. If I have one of your cars up in my train yard I have no authority to repack that car because it is over date, and I cannot put it on the repair track for repacking only. If the repacking date is more than twelve months old, am I justified in repacking your car?

Secretary Sternberg: I see nothing to prohibit you from marking a car to your repair track to repack a journal box if beyond twelve months, providing that car requires other repairs.

J. E. Gordon (N. Y. C. & St. L.): The intention of that rule is that no car can be packed unless it has a mechanical defect.

C. J. Wymer (C. & C. I.): The committee had in mind that the work was not sufficiently important to justify taking the car out of service and delaying it for repacking alone, and in order to justify the charge the car must require other work than repacking the journals.

C. W. Kimbell (Southern): Any previous marking would show the date that work, if necessary, may be done. Does that mean the cleaning or is it the condition of the packing that would cause you to clean it off? If one box needed packing before the other, would that give you authority to repack the others?

The Chairman: If the car is not stenciled you can pack the boxes.

E. S. Swift (Wabash): When we had this rule before we had to make a special repair card. How are you going to tell whether there are other repairs if you have to make special bills for repacking the journal boxes? How is a bill clerk to check to see what other repairs were made?

W. F. Armstrong (B. & O): A car is given to me with four pairs of slid flat wheels with a defect card attached. The question was asked me if I would apply wheels on the authority of a defect card. May I render a bill for the application of the slid flat wheels and then pack those same eight boxes, stencil the car and charge to the owner?

Mr. Gordon: If you have a car in your charge with four pairs of slid flat wheels and no stencil mark on the car, you can charge for packing the boxes.

Joe Martin (N. Y. C.): Paragraph A of the rule as written covers Mr. Armstrong's case.

Rule 70

New form, first two paragraphs—Cars stenciled "wrought-steel wheels" *or* "*1-W wrought steel wheels,*" if found with cast-iron, cast-steel or steel-tired wheels. *Cars stenciled "wrought-steel wheels," for one end of car only, if such end of car is found with one or both pair cast-iron, cast-steel or steel-tired wheels.*

Cars stenciled "cast-steel wheels," if found with cast-iron or

steel-tired wheels. *Cars stenciled "cast-steel wheels," for one end of car only, if such end of car is found with one or both pair cast-iron, steel tired or 1-W wrought-steel wheels.*

Reason—To afford protection to car owner in the application of wheel betterments to one end of car.

Mr. Williams: This may be the intention, although we do not know the necessity and use of everything. The second paragraph of the proposed form says, "Cars stenciled cast-steel wheels" if found with cast-iron or steel-tired wheels. Cars stenciled "cast-steel wheels," for the end of car only, if such end of car is found with one or both pairs cast-iron, steel-tired or wrought-steel wheels. In the first sentence no mention is made of steel-tired wheels, but later on it says cast-iron, steel-tired or wrought-steel wheels.

Mr. Hawthorne: Mr. Williams is correct. That is a typographical error, and will be taken care of in the revision of the rules. In preparing this report at Atlantic City this part was changed by the Arbitration Committee to provide for the application of wrought-steel wheels.

Rule 75

New rule (formerly second paragraph, Rule 71)—Brake burn: Wheels having defective treads on account of cracks or *combiness* due to heating.

Reason: As recommended by the Committee on Wheels.

Mr. Cheadle: It says "on account of cracks or combiness due to heating." Cracks in the center of the wheel do not effect it a great deal. I want to know if it is necessary that these cracks cross the center of the wheel, or any cracks whatever.

The Chairman: You will have to read Rule 71 to get your answer. It says, if it does not affect the serviceability of the wheel.

Mr. Hawthorne: I think he will get the information he wants from the Wheel Committee's report.

Mr. Ryan: If you have brakes left set and you heat the wheels until they are elongated and cracked, is that handling line or owners' responsibility? Is that term the same as a brake burn?

Mr. Fitzgerald: I do not know why any railroad company would ask a car owner to pay for a car damaged as you say due to his operation with set hand brakes. On my road I would say, "No Bill."

Mr. Ryan: On the bills we are getting, they say, "Brake burn due to hand brake set."

Mr. Fitzgerald: That may be done, the wheel may become heated and blistered, and they would bill the car owner for the damaged wheel.

Mr. Ryan: An overheated wheel is heated the entire circumference. The tread becomes full of small cracks and that is the defect that seems to be at issue at the present time. I do not think that this condition should be considered a brake burned wheel.

Secretary Sternberg: If you can establish the fact that the hand brake was the cause of the overheated wheel, you could reject the charge. There are some places where they set the retainer up in such a position as to sometimes cause overheating and brake burn and that is owners' responsibility.

Mr. Ryan: Is it the sense of the rule that an overheated wheel and a brake burned wheel is one and the same thing.

Henry Andrews (N. Y. C.): The Wheel Committee answers that very plainly in Section 8 of their report.

Discussion of passenger car rules

Rule 15

New sentence in Section C—Air-brake hose applied must be new and made in accordance with specifications for A. R. A. standard 1⅜ in. hose, and so labeled.

Similarly, to justify bill, steam or signal hose applied to foreign cars must be new and made in accordance with A. R. A. specifications.

Reason: It is felt that new hose should be used in repairs to foreign cars.

Mr. Owen: The intention is that we must apply new hose to foreign cars, regardless of whether it is a handling line or owner's responsibility; that we cannot apply second-hand hose even if it is a handling line's responsibility.

Mr. Hawthorne: You can put on the defect card, but this is a billing proposition, and you must put on new hose if you are going to make a bill.

Mr. Owen: As I understand it, you do not have to apply a new hose when it is a delivering line's responsibility. I would like to have some explanation of that.

The Chairman: If I loose off an angle cock and hose, have I the right to put on a second-hand air hose?

A. Kipp (N. Y. O. & W.): I think you have a right to put on a second-hand hose if you wish, but you cannot bill for it. They would not accept the bill if you offered it.

Mr. Smith: The proposed form is very clear. The new form should be applied simply to justify bills. Steam and signal hose must be new and application made in accordance with the A. R. A. standard. In order to justify a bill only a new hose must be used.

Mr. Fitzgerald: No provision is made for bill in the rule now in force. You have to give the owner new hose under the rules we are now working under.

The Chairman: That is my idea. We have on hand at our reclaim yard several thousand second-hand air hose, and we have applied new ones in place. It is very bad practice to apply second-hand hose.

Mr. Hawthorne: The Arbitration Committee have been listening to your arguments and there is an apparent confusion in Rule 15 in the second sentence. They will give that matter consideration and try to make it clear. I think it is a bad practice to put second-hand air hose, steam or signal hose, on even your own cars.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Damage not associated with unfair usage defects

Great Northern box car No. 220075 was repaired by the Chicago, Rock Island & Pacific for which a repair bill was rendered for the amount of $3,859.26. The C. R. I. & P. admitted that the car was chained to another car from which the coupler was missing but it contended that it did not charge for any repairs which were the result of any such handling. The Great Northern contended that there were a number of items charged which should have been marked "No bill," stating that upon taking up the matter with the Pennsylvania which delivered the car to the C. R. I. & P., it was advised that the car had had no bad order record against it when interchanged. This was considered by the Great Northern as an authentic record and that all the repairs made to the car were the result of unfair usage as prescribed by

Section 5, Paragraph E, Rule 32, and contended that the C. R. I. & P. should authorize a counterbill for the entire amount charged. The C. R. I. & P. admitted that when the Pensylvania delivered the car it had had no bad order record against it, but the reason for this was that the inspection and carding in the Chicago terminal district is done by the receiving road.

The Arbitration Committee in rendering its decision sustained the contention of the Chicago, Rock Island & Pacific.—*Case No. 1377, Great Northern vs. Chicago, Rock Island & Pacific.*

Joint statement not conclusive evidence for repairs claimed not made

On December 5, 1923, St. Louis & Belleville Electric car No. 658 was repaired on the lines of the Chicago, Milwaukee & St. Paul. Among the repair items listed were eight truss rod turnbuckles tightened which the C., M. & St. P. claimed that the owner refused to pay for on the grounds that the work had not been done. The owner stated that it had received and approved for payment a bill for $36.70 which covered all of the items listed by the repairing line, and that the claim of the repairing line that it had not been paid for tightening the truss rods was incorrect. However, the owner held the car, when it arrived on its lines, for the reason that it had received from the Great Northern a bill covering the tightening of eight turnbuckles 28 days previous to the time the C., M. & St. P. billed it for the same work. After accepting the car, the owner maintained that it could not find any evidence that the turnbuckles had been moved on the rods. A joint statement and the repair cards of the Great Northern and the C., M. & St. P. were submitted as evidence that this work was charged by both lines, which, the owner contended, carried the same authority as the joint evidence card when covering wrong repairs, and which entitled it to a recharge authority for the amount paid the Chicago, Milwaukee & St. Paul for trussing this car.

In rendering its decision, the Arbitration Committee stated, "The charge of the Chicago, Milwaukee & St. Paul Railway is sustained. The principle of Decision No. 1150. applies."—*Case No. 1379, Chicago, Milwaukee & St. Paul vs. St. Louis & Belleville Electric.*

A case where Rules 32 and 43 do not apply

The Terminal Railroad Association of St. Louis inspection certificate dated June 6, 1924, covering the condition of Louisville & Nashville box car No. 64320, was forwarded to the L. & N. with a letter dated June 18. explaining that the estimated cost of repairs exceeded the allowance under A.R.A. Rule 120 and the L. & N. was requested to furnish disposition of the car. The T. R. A. contended that the case did not come within the provisions of the footnote of Rule 43 and that there were no requirements that a statement of the handling of the car should be furnished It contended further that the damage to the car did not come under the provisions of Rule 32 and that the defects on the car were owner's liability. The L. & N., upon investigation, found that the car was damaged as a result of four cars loaded with grain being released without rider protection, which permitted them to collide with L. & N. car, which was standing on the track; and claimed that the handling line was responsible for the damage to the car, as it did not comply with Section d, Item 4 of Rule 32.

The Arbitration Committe rendered the following decision: "The car was not damaged to the extent shown in the foot note to Rule 43; therefore, Item 4, Section d, Rule 32, does not apply. The car owner is responsible." —*Case No. 1378, Terminal Railroad Association of St. Louis vs. Louisville & Nashville.*

Car damage as a result of a loose coupler carrier iron

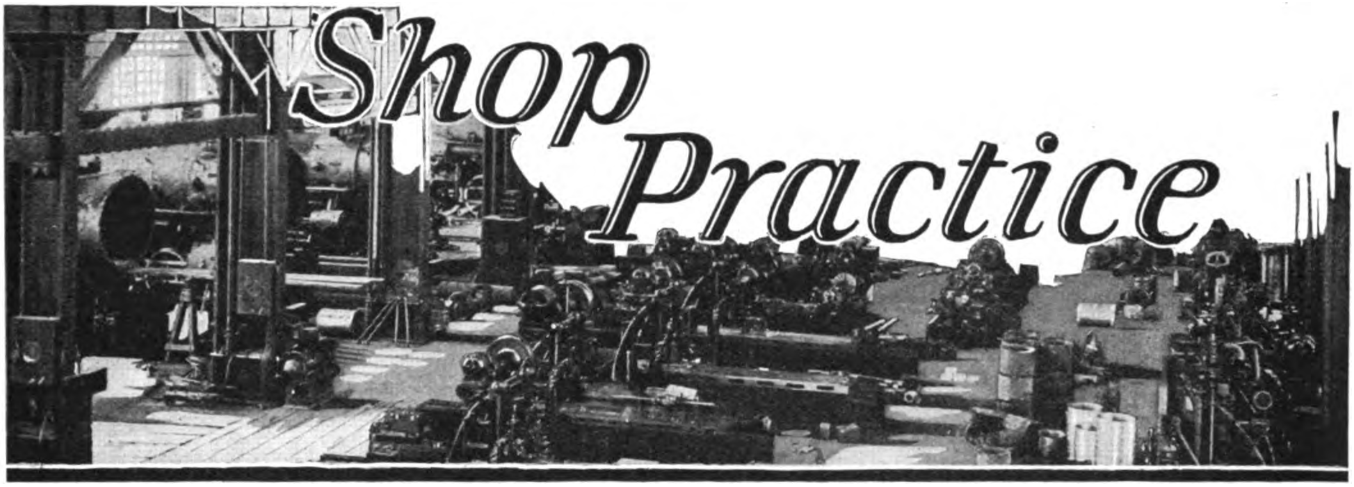
On June 24, 1924, a Bessemer & Lake Erie train of 49 cars and two locomotives, in stopping to enter a siding, ran by a switch. In taking slack to back up to clear the switch, the train broke in two between Gulf, Mobile & Northern car No. 747, a steel underframe, side door ballast type gondola car, and Union Railroad car No. 7163, the eleventh and twelfth cars from the locomotives. The cause of the accident was that the coupler on the U. R. R. car was hanging down because the carrier iron was loose at one end. The engineman, not knowing that the train was broken in two, backed the head end into the rear end of the train, damaging the two cars mentioned above. On July 3, 1924, the G., M. & N. car was reported to the owner for disposition under Rule 120. As the two contending roads could not agree as to the circumstances under which the car was damaged, two joint inspections of the car were made, both of which resulted in disagreements as to the condition of the car before the break-in-two and as to the responsibility for the damage. The B. & L. E. contended that, when built, the car was probably not of the best design for use in heavy train service and that it had the usual corrosion resulting from thirteen years' service, the damage being primarily due to the condition of the car and not to the accident in question. The G., M. & N. complained that owing to the circumstances under which the car was damaged, under Section D, Items 2 and 5, Rule 32, the handling line was responsible and should have reported the car under Rule 112, instead of under Rule 120.

The Arbitration Committee rendered the following decision: "The evidence indicates that the damage did not occur at the time the train broke in two between G., M. & N. car No. 747 and U. R. R. car No. 7163, the eleventh and twelfth cars from the head end. It further shows that the engineman, having run by the switch and with the train broken in two, backed the forward section into the rear section, thereby causing the damage. Such mishandling is the responsibility of the handling line."—*Case No. 1376, Bessemer & Lake Erie vs. Gulf, Mobile & Northern.*

Car not properly stenciled when safety valves were tested

The Hocking Valley rendered to the Texas Company its repair card dated June 16, 1924, covering the testing of safety valves on T. C. X. car No. 1300 on account of the car being stenciled "last date 6-13-22 The Texas Company." The car arrived at the Norfolk plant of the Texas Company and the safety valves were tested by the owner on June 4, 1924, on account of the car being stenciled "expired date 6-12-22 The Texas Company N. T." When this fact was noticed by the owner, it was evident that the Hocking Valley had either not applied the proper stenciling or failed to obliterate the old stencil. Accordingly, the owner requested the Hocking Valley for offset authority to cancel the repair charge which was refused.

In a decision rendered by the Arbitration Committee it was stated that "the Hocking Valley evidently failed to remove the old markings and apply new markings in connection with the testing of safety valves. Therefore, their bill should be cancelled."—*Case No. 1427, The Texas Company vs. Hocking Valley.*



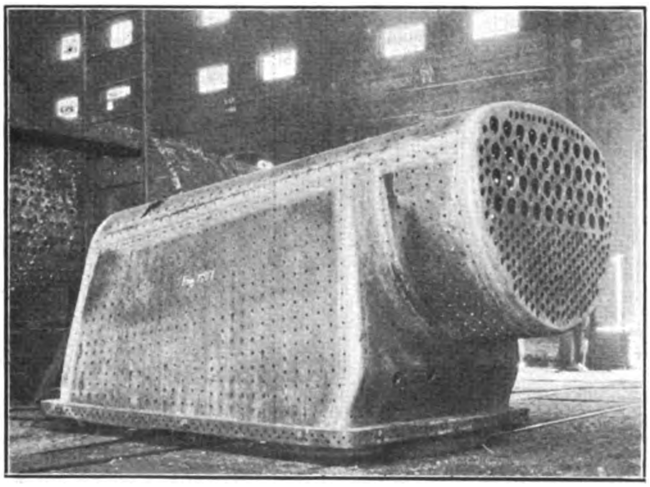
Repairing locomotive parts by the welding processes*

Selection of the correct process, calculating costs and proficient operators important factors

By G. H. Gjertsen

Master welder, Northern Pacific, St. Paul, Minn.

As it would be impossible to cover the entire field of welding of locomotive parts by the three principal processes, namely, the oxy-acetylene, electric and Thermit, the contents of this paper will be confined as much as possible to the major welding operations and to



Fire box completely oxy-acetylene welded

such other operations as are most common in the general construction and maintenance of locomotives.

The choice of method to be used should only be made after due consideration of several factors, such as the kind of metal to be welded, the size and character of the part, the location of the break, whether it is to be welded in place and the cost of doing the work, bearing in mind that the first cost must be considered in the light of the relative qualities of the weld in service. Gas welding, electric welding and Thermit welding each has their advantages in its field and is capable of accomplishing some particular operation better than another method.

A basis for determining the process to be used

In railroad work the Thermit is almost entirely limited to the welding of engine frames, while the oxy-acetylene and electric arc cover much the same field in the welding of many of the steel parts. No definite limit can be placed on the use of any of these processes where either may be used with success. If equal results can be obtained it is, of course, desired to use the process with which the work can be performed most economically and to the best advantage. The general run of castings and parts made of cast iron or brass, bronze, aluminum, etc., (non-ferrous class) are welded with the oxy-acetylene process. In cast iron, many heavy sections, however, such as are sometimes encountered in repairs to shop machinery are successfully welded with the Thermit process. Other heavy cast iron sections such as cannot be properly preheated for either the oxy-acetylene or Thermit process, are repaired by the electric arc process using the usual system of distribution of steel studs about the welded junction.

The welding of heavy cast-iron parts may be accomplished with any one of the three processes, the process selected depending on the outlined conditions. However, generally speaking, where the conditions are favorable for proper preheating and execution of the work, the oxy-acetylene process is preferred in the welding of cast iron parts.

In compiling a list of parts on which fusion welding has become standard practice in the construction and

* A paper read before the Fall Meeting of the American Welding Society, held at Buffalo, N. Y., during the week of November 15, 1926.

maintenance of locomotives, it is only possible, in a limited space, to touch on the major applications and such other applications as are most commonly performed in general routine work in the shops.

The process selected in welding on steel parts where either the oxy-acetylene or electric arc process may be used will no doubt offer much room for discussion.

It must be borne in mind, however, that all operators are not of the highest skilled type and able to do full justice to the process they represent. The proficiency of the operators, whether it be good or bad, whether it be gas, electric or thermit, many times results in the establishing of practices that are not entirely justified, or based on actual results that could be obtained.

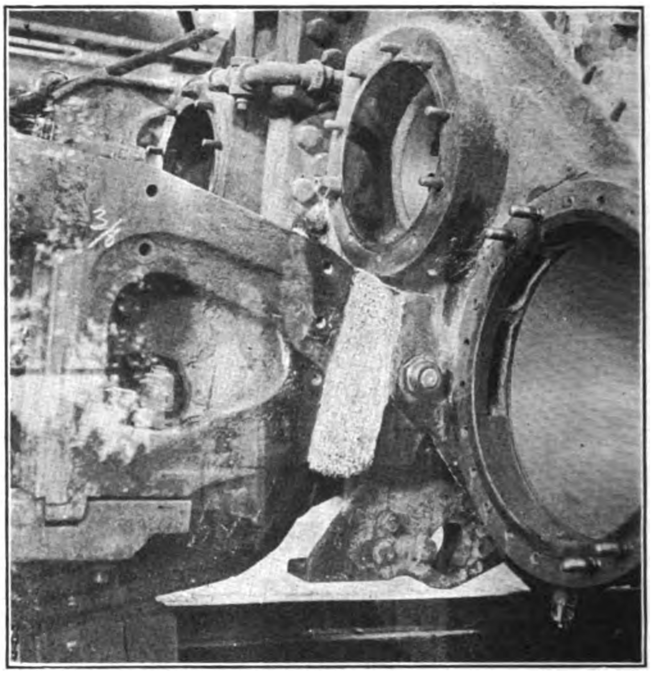
The equipment and facilities with which to perform the work must also be considered, as few railroads are fully or adequately equipped to do their work at all points with all of the three processes to the extent that the lowest figures in economy can be effected. Where equal or satisfactory results can be obtained, the selection of the process to be used should be based on the costs of the application.

Determining welding costs

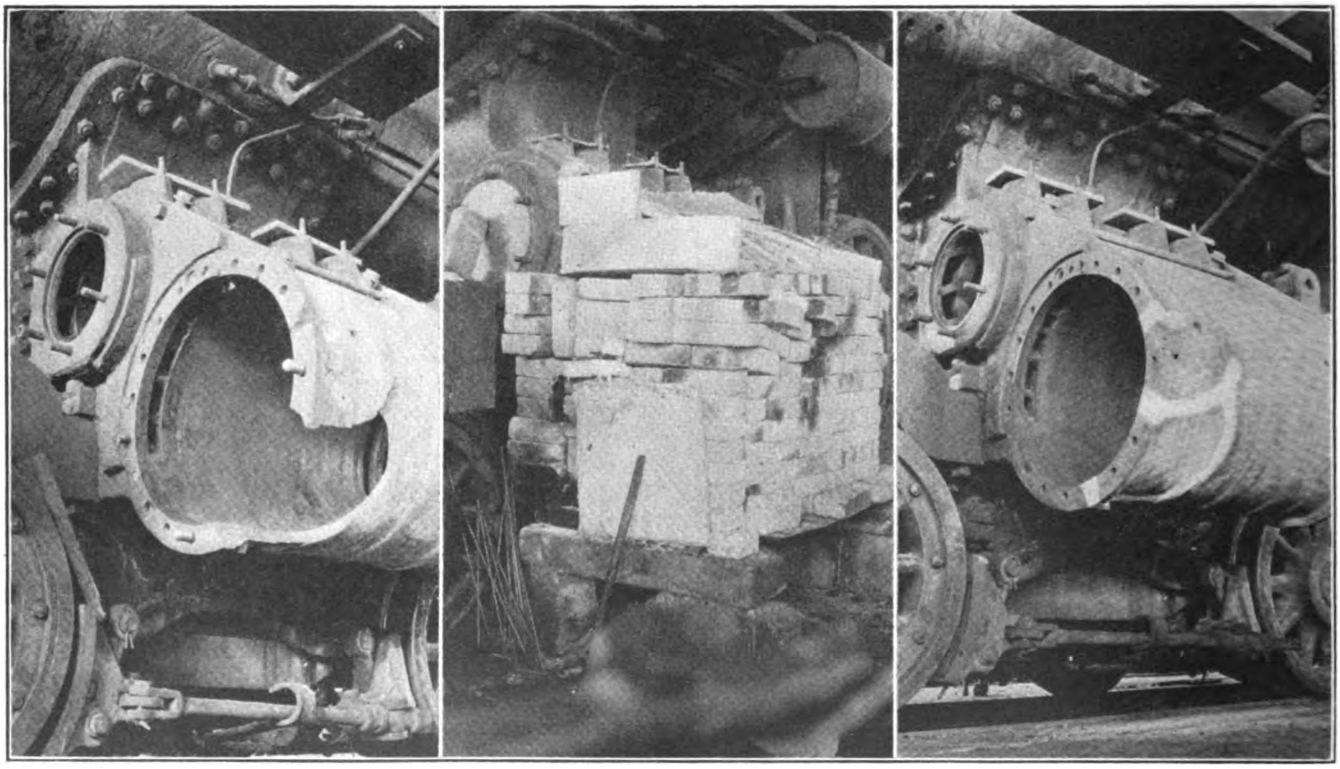
In calculating the economies effected by welding, it is necessary to keep extensive records at least for a sufficient period of time to strike a fair average of the varying conditions under which the work comes in and is executed, as well as from the service rendered. The cost of making gas welds, for instance, can be arrived at by checking the time required to do the work, the quantity of gases, welding rod, etc., used, and the cost of finishing the work after the welding is completed, if further finishing is required.

The cost of making electric welds can be calculated in the same manner, excepting that the electric energy or current used, must be checked instead of the gas which is used with the oxy-acetylene process. The rating of the welding set or tables provided for this purpose may be used in calculating the current used, or this may also be determined by the use of a meter.

With the Thermit welds the time is checked, the weight of materials used, etc. In addition to this, in making welds with any of the three processes, it is, of course, necessary to include the cost of preparing the work, such as cutting out the vee, chipping or sandblasting, preheating and annealing, as well as the necessary dismantling, etc. Scrap value and overhead should be included.



Locomotive frame repaired by the Thermit process



Broken cylinder repaired by gas welding—Center view shows method of preheating—Cost of finished weld, $71—Estimated saving, $691

If, for instance, the repaired job is a casting, it should be given a value rating as compared with a new one, as

all reclaimed material cannot be considered to be of the same value as new.

A few examples of savings effected on some of the major operations may be noted as follows:

No.	Part	Total cost new	Total cost to weld, including overhead	Total scrap value	Total saving
6	Driving wheel centers..	$1,500.00	$147.31	$90.00	$1,262.69
6	Locomotive cylinders....	5,300.00	740.13	540.00	4,019.87
6	Engine tender bolsters..	630.00	124.92	67.30	437.78

In order that the success and economy of the various welding applications may be definitely known, careful and complete records must be kept of all the sufficiently important operations.

Those responsible for the application and use of the various welding processes must be in a position to know definitely the results in service, in order that the extending and developing of this work may be handled wisely and to the best advantage.

Bells, injectors, switch stands and jacks successfully repaired by gas welding

Checking and testing operators

While it would be impossible to keep records of the numerous minor operations performed, yet all of the major and important operations, such as firebox work, locomotive cylinders, frames, car work, etc., should, by all means, be recorded. Where stamping is practicable, this may be done, showing the date and name of the place where the weld was made, also the operator's initials or identity.

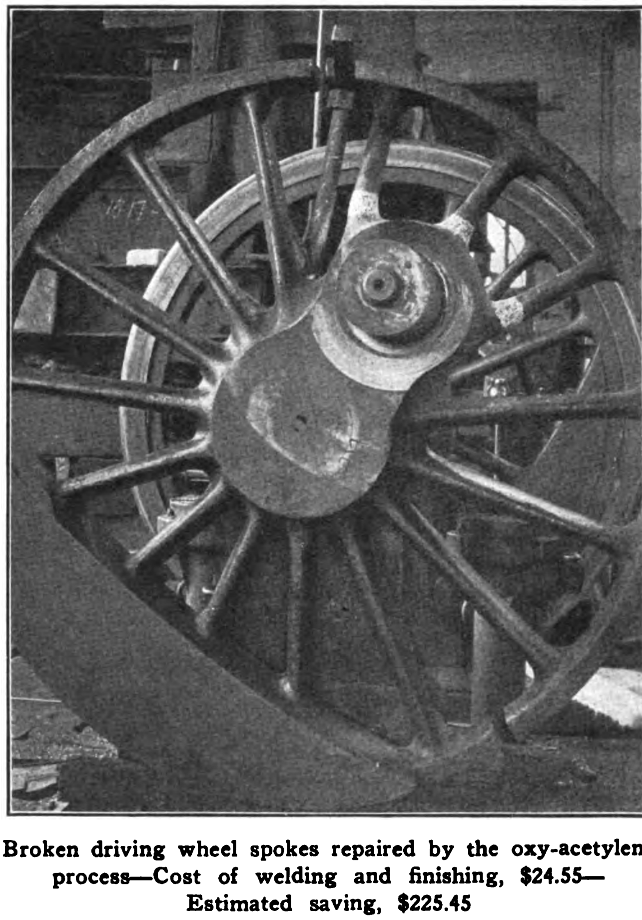
Failures of welds should be made known to those in charge where the work was performed, and they in turn make it known to the welder who performed the work in order that the cause of the failure may be determined. By carefully following up any work that has not given satisfactory results, all concerned will be more on the alert to improve the work. It will likewise make it possible to determine the success of the practice.

The inspection of welding must necessarily be largely a matter of observation, both of the operator while he is at work and of the appearance of the weld. Other tests, except in the case of pressure vessels, depend upon the destruction of the weld and are, therefore, inapplicable.

A competent welding instructor or supervisor can readily tell whether an operator is qualified or not to perform the work assigned to him, and none but competent operators should be allowed to handle important jobs. The ability of welders assigned to do important work should be further ascertained by sample welds submitted to laboratory tests.

Automatic electric arc welding

In building up driving wheel centers and trailer wheel centers with automatic electric arc welding equipment, the work is handled in a wheel lathe, the wheels revolving as in an ordinary turning operation. Where much of this work is to be done it is advisable to set aside an old wheel lathe for this purpose as the speed of the lathe must be cut down to about three revolutions per hour to handle the largest driving wheel centers successfully. This can, of course, also be accomplished by putting up an extra countershaft or any other speed arrangement so that the lathe can be used for both purposes. The surface travel of the work should be about 9 in. per minute for the best results. When using a 3/16-in. wire a surface speed of 6 in. to 12 in. per minute shoud be used. However, the thickness of the layer of metal put on will vary with the speed. In covering 6 in. per minute the layer of metal put on will be twice the size of that put on at a speed of 12 in. and in using a slower speed there is less chance of breaking the arc where the surface is rough.



Broken driving wheel spokes repaired by the oxy-acetylene process—Cost of welding and finishing, $24.55—Estimated saving, $225.45

The welding wire used in automatic welding is supplied in coils shipped on spools. About 250 lb. of wire is on each spool.

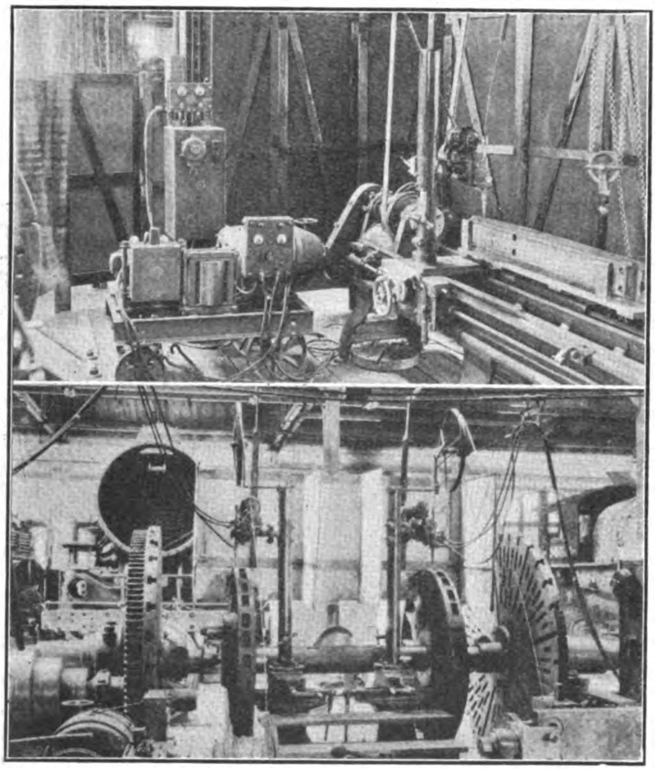
In the type of driving wheels shown in one of the illustrations it will be noticed that they are recessed in the center. The outside surfaces of the face of the wheel are first built up with the automatic equipment. One

operator operates both automatic heads and on 62-in. wheels of this type about five hours are required for the automatic operation where a layer of metal about 3/16-in. thick is put on the surface. The filling in of the bridges is done by hand and requires about three hours on each wheel. Where the wheel has a solid face and can be finished with the automatic, better time can be made.

List of parts covering the most common applications of fusion welding in the construction and maintenance of locomotives

Locomotive Work

Locomotive cylinders	Oxyacetylene process
Firebox work, general	Gas or electric (optional)
Motion work (building up worn surfaces)	Electric
Building up locomotive piston heads (mang. bronze)	Gas
Building up air pump piston heads (mang. bronze)	Gas
Building up locomotive guides	Electric (automatic operation)
Building up steel driving wheel centers (diam.)	Electric (automatic operation)
Building up trailer wheel centers (diam.)	Electric (automatic operation)
Building up steel driving box flanges	Electric (automatic operation)
Welding spokes driving wheel centers (cast iron)	Gas process
Welding spokes trailer wheel centers (cast iron)	Gas process
Welding spokes trailer wheel centers (steel)	Gas or electric
Welding spokes driving wheel centers (steel)	Gas or electric
Building up worn engine truck jaws (cast iron)	Gas
Building up worn engine truck boxes (cast iron)	Gas
Building up broken lugs driving boxes (steel)	Gas or electric



Building up crosshead guides and driving wheel centers by automatic arc welding

Building up broken lugs driving box cellars (cast iron)	Gas
Welding broken engine truck cellars	Gas
Welding broken tank truck cellars	Gas
Welding broken driving box cellars	Gas
Building up worn crossheads	Gas or electric
Building up broken lugs air brake cylinders	Gas
Building up broken lugs air brake reservoirs	Gas
Repairs to injectors and lubricators	Gas
Welding on grates and ashpan slides	Gas
Building up worn brake beams	Gas or electric
Building up worn equalizers	Gas or electric
Welding on steam pipes	Gas
Welding on nozzle stands	Gas
Welding on air compressor cylinders	Gas
Welding and building up on spring saddles	Gas or electric
Welding and building up on engine truck swing links	Gas or electric
Building up lateral main rod brasses	Gas
Welding locomotive frames	Thermit, gas, electric
Welding engine truck frames	Gas or electric
Welding bells	Gas
Building up worn stoker screws	Gas or electric
Welding flues to flue sheet	Electric
Broken mud rings	Gas or electric

Car Work

Bolsters	Gas or electric
Truck sides	Gas or electric
Couplers	Gas or electric
Coupler knuckles	Gas or electric
Axles (end collars)	Gas or electric
Truck pedestals	Gas
Air reservoirs	Gas
Center plates	Gas or electric

The illustrations showing the automatic equipment set up for building up guides show one set of equipment complete, which includes one motor-generator set, one control panel and one automatic welding head. The latter is mounted on the carriage of the lathe in such a way that it can be raised and lowered to accommodate the work. This arrangement can be used for any flat work, also for work that is round and can be revolved in the lathe centers or in the chuck.

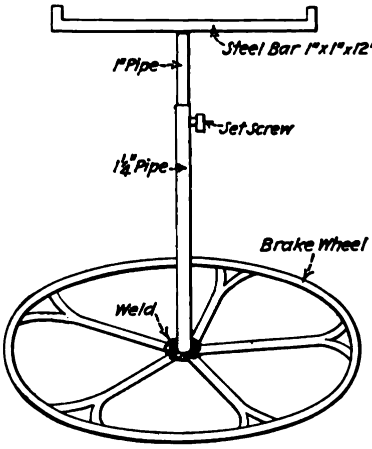
The automatic equipment is very sensitive and cannot be operated successfully from a line where the electric current has too much of a variation in voltage or where there is interference from heavy loads cutting in. A sudden fluctuation of current has a tendency to break the arc when the machine is working to its capacity and interferes with the smoothness of the finished welded product.

Where 3/16-in. wire is used, a current of approximately 250 amp. is required and if a separate motor-generator set is used for each automatic head, it should be of 300 amp. capacity. Each automatic head will deposit from two to three times as much metal per hour as a hand operator and consumes seven to eight kw. per hour.

An accessory for the blacksmith or pipe shop

By Joseph C. Coyle

A HANDY accessory used in the blacksmith shop of the Denver & Rio Grande Western, Denver, Col., is a movable, adjustable support for holding the free end of bar iron or pipe, the other end of which is being worked on. It is made by welding an 18-in.



A portable support for holding one end of long pieces of bar iron or pipe

section of iron pipe to an old brake wheel. A similar section of one-inch round steel slips inside the pipe. This section can be adjusted to any height desired and is held in place with a set screw. A cross piece, 12 in. long of 1-in. by 1¼-in. steel turned up at each end, is welded to the top as shown in the sketch. The ends are turned up to prevent the bar from sliding off.

Lehigh Valley has well organized system shops

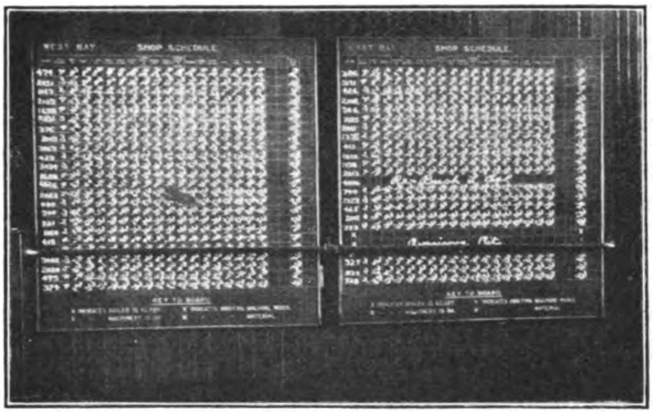
Teamwork among the shop forces is basis of production system—Detail cost records kept

Part II

Delivery truck train leaving the storehouse annex.

GOOD organization and teamwork on the part of the division master mechanics with the various departments, together with a good utilization of available shop facilities, are undoubtedly the outstanding features in the operation of the Lehigh Valley system shops, Sayre, Pa. Sixty days before a locomotive is due for classified repairs, the division master mechanic submits a report to the superintendent of motive power showing the condition of the locomotive at that time and what items will probably be needed when it goes into the shop for classified repairs. This report is then approved, in whole or in part, by the superintendent of motive power who forwards it to the shop superintendent at Sayre.

Upon receipt of the report by the shop superintendent, he in turn notifies the district storekeeper at Sayre. This advance notice on the part of the mechanical department gives the stores department an opportunity to have all the material needed on hand when the locomotive arrives at the shop. Quite often the machine shop also needs some extra time to get a part finished, such as a pair of cylinders, before the locomotive comes in for repairs. Cylinders are machined on a storehouse work order to the machine shop, but are not charged out. If it is found when the locomotive is stripped that the cylinders can be repaired by welding, the new cylinders are returned to the stores department.

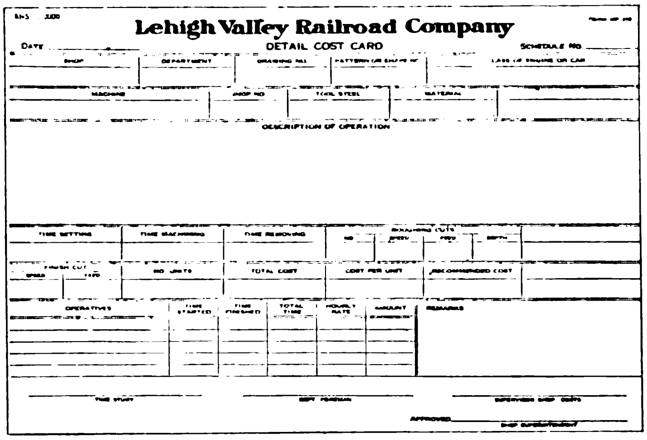


The shop schedule board

The division master mechanic's report is, of course, checked by a general inspection which is made on the locomotive when it arrives at the shop, to determine what class of repairs the locomotive is to get. This general inspection creates a shop order for material. The shop inspection made after the parts have been delivered to the various departments from the lye vat (described in Part I, in the November issue) creates the order for small parts.

The repair schedule for each locomotive is made out after the work of stripping has been completed. A meeting of all foremen is held each afternoon at four o'clock and the date out is set for each department. The district storekeeper or his assistant is present at all foremen's meetings when the schedule of repairs is being planned and effects a liaison between the two departments so that material will be available when needed.

Nothing is permitted to disturb the program of repairs after it has once been scheduled. If a locomotive gets behind schedule, the case is taken up at the foremen's meeting and steps are immediately taken to bring the work up to date. There is one gang for each six pits. Competition is keen between the different gang foremen and their respective gangs. When a locomotive gets behind it is charged up as a "loss" to the gang foreman. The resultant competition keeps the men interested which, of course, is an essential factor in improving production.



Card used by the supervisor of shop costs in keeping a record of the detail costs of different operations

The scheduling system

The scheduling system has the combined features of simplicity and effectiveness. Each locomotive is sched-

uled according to what the various inspection reports show. Nine items, namely, frames, brasses and bolts, cylinders, lateral, crossheads, guides, main rods, parallel rods, wheels and tires, together with a list of missing equipment, are reported on by the mechanical inspector who inspects the locomotive upon arrival at the shop. This report is turned in to the general foreman as soon as possible after the arrival of the locomotive at the shop. A yard inspection of the boiler is also made and a report is turned in on the condition of the tubes and flues, back tube sheet, right and left side sheets, door sheet, crown sheets, throat sheet, crown stays, fusible plugs, etc. This report, combined with a report of the internal inspection after the engine has been stripped and the tubes removed, and the report of the general inspection, determines the class of repairs the locomotive is to receive.

Only one form, a duplicate of the shop schedule board, shown in one of the illustrations, is in actual circulation. A copy of this form is provided for all the department and gang foremen and it shows the engine number, class of repairs, the date in, and the scheduled date for completion of the principal items of work to be done on the locomotive. The date out is shown in the last column. The shop schedule form, various inspection forms, report forms, etc., are made up on mimeograph sheets. Forms are also provided for reporting delays in erecting shop operations and delivery of material to the general foreman.

The scheduling department keeps a careful check on the operation of the scheduling system and makes a daily report to the shop superintendent of any discrepancies between the scheduled and the actual days that work is completed. The man in charge of the schedule board watches the progress on each locomotive and makes a check at all times.

The delivery system

The stores department is able to keep in close touch with the progress of repairs, not only through its representative but by knowing the actual progress of the work by comparing to the schedule. The shop inspection creates the orders for small parts which are delivered by trucks operating on a regular schedule which is rigidly adhered to. A description of the system used in the locomotive shops at Sayre was published in the July, 1926, issue of the *Railway Mechanical Engineer,* as part of an article on the general subject of handling material in railroad shops.

LEHIGH VALLEY RAILROAD Form No.2

SHOP SCHEDULE

Engine	Class Re-pairs	Date in	Wheels	Driv Box	Shoes Wedg-es	Sprg Rigg	Blr. Work	Steam Pipes & Units	Blr. Test	Eng. Whl-ed	St'm Chst & Valv	Guides	Valv Set	Brk Rigg	Rods	Cab Work	Tank	Paint		Date to be Out

Key to Board:
"A" - Indicates Boiler is Ready
"X" - " Machinery is O.K.
"V" - " Awaiting Machine work
"M" - " Awaiting Material

Shop schedule form—Copies are prepared for all department foremen—It is a duplication of the schedule board

Five trucks are used to haul trailers from the storehouse to material stations located at strategic points throughout the locomotive shops, at which the truck train stops for the delivery of material and for the collection of orders for material. A hook is provided at each station on which all orders for material to be delivered to that station are hung, to be collected by the delivery man. The stores department has charge of the trucking system and the scheduling of truck deliveries to all departments.

LEHIGH VALLEY RAILROAD

Mimeo. No.16

REPORT OF MACHINES IDLE

Shop No.________ Date______________19___

SECTION:

Machine No.	Man's Check Number	CAUSE No Work	No Man	No Jigs	No Tools	Break-down		Remarks

CORRECT____________________ (S)____________________
FOREMAN

This form to be filled out one-half (½) hour after the starting time of each shift by Piecework Inspector, with assistance of Foreman and Forwarded to Schedule Office.

Report showing machines idle and causes for idleness

All heavy castings are handled after the regular working hours so as not to tie up the crane service. Two flat cars, on which all heavy material is transported, are switched daily between the main storehouse and the locomotive shop, one car being spotted at the storehouse and the other at the shop for loading or unloading during the day.

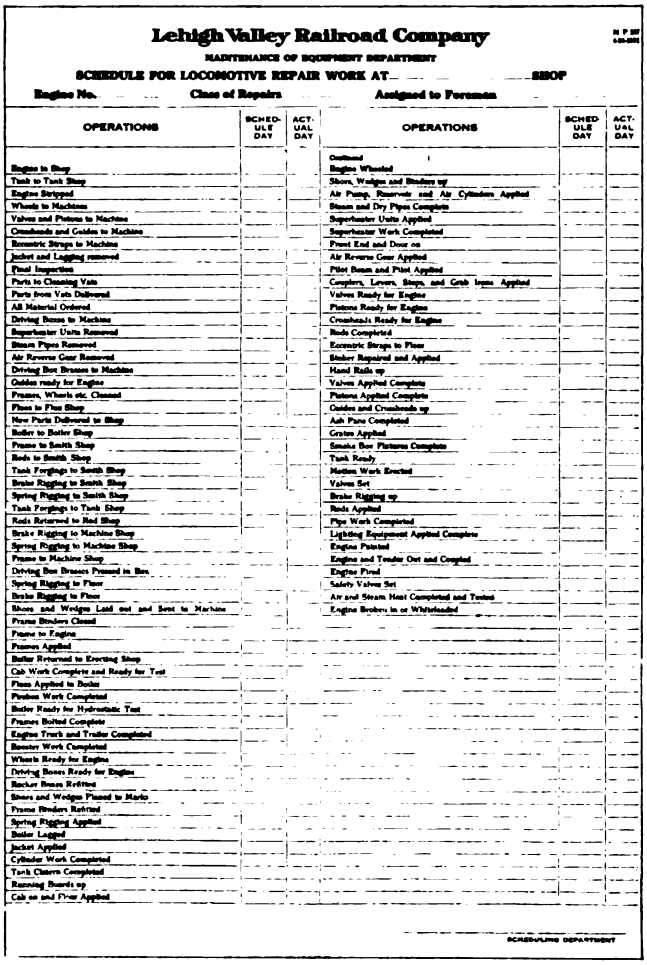
The importance of having adequate crane service at all times during working hours and the need for co-operation in seeing that the time of each crane is used to advantage on the part of all employees is emphasized by the shop management. Each employee having any occasion to use crane service is required to report any delay in obtaining it. A mimeographed report form is provided on which is a space for the employee's name, kind of machine, machine number and department in which the machine is located. This report shows the number of hours worked, time waiting for crane, number of lifts per day, together with any remarks the employee

feels may be of use towards providing efficient crane service.

A sub-storehouse in charge of a stores department employee is located in the center of the locomotive shop, where certain small items, such as Lassiter bolts, pipe fittings, washers, nuts, machine bolts and other similar articles, are carried. This plan eliminates the necessity of handling such items in small quantities by the delivery system. A number of small racks are also located at convenient points in the shop where a 15-days' supply of live items, such as are carried in the sub-storehouse, are maintained, enabling the shop men to obtain such items without waste of time. These racks or bins are replenished daily.

The shop order system

Requisitions for finished material are also made on the system shops by the stores department, not only to re-


Lehigh Valley Railroad Company

MAINTENANCE OF EQUIPMENT DEPARTMENT

SCHEDULE FOR LOCOMOTIVE REPAIR WORK AT ______ SHOP

Engine No. ______ Class of Repairs ______ Assigned to Foreman ______

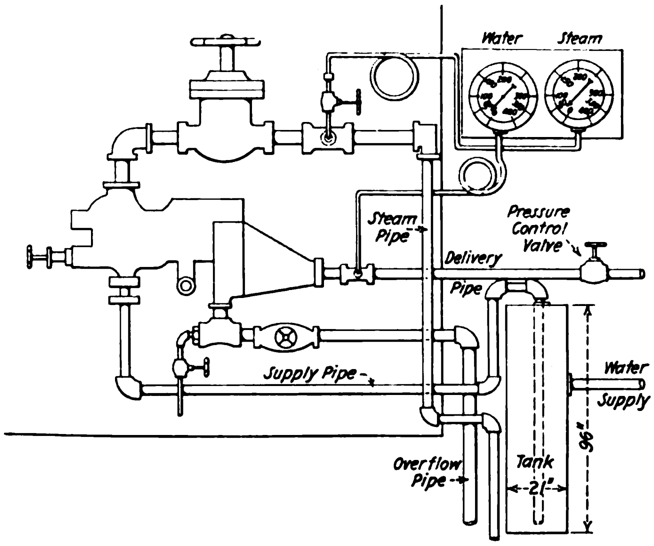
OPERATIONS	SCHEDULE DAY	ACTUAL DAY	OPERATIONS	SCHEDULE DAY	ACTUAL DAY
			Continued		
Engine to Shop			Engine Wheeled		
Tank to Tank Shop			Shoes, Wedges and Binders up		
Engine Stripped			Air Pump, Reservoirs and Air Cylinders Applied		
Wheels to Machines			Steam and Dry Pipes Complete		
Valves and Pistons to Machine			Superheater Units Applied		
Crossheads and Guides to Machine			Superheater Work Completed		
Eccentric Straps to Machine			Front End and Door on		
Jacket and Lagging removed			Air Reverse Gear Applied		
Final Inspection			Pilot Beam and Pilot Applied		
Parts to Cleaning Vats			Couplers, Levers, Steps, and Grab Irons Applied		
Parts from Vats Delivered			Valves Ready for Engine		
All Material Ordered			Pistons Ready for Engine		
Driving Boxes to Machine			Crossheads Ready for Engine		
Superheater Units Removed			Rods Completed		
Steam Pipes Removed			Eccentric Straps to Floor		
Air Reverse Gear Removed			Stoker Repaired and Applied		
Driving Box Brasses to Machine			Hand Rails up		
Guides ready for Engine			Valves Applied Complete		
Frames, Wheels etc. Cleaned			Pistons Applied Complete		
Flues to Flue Shop			Guides and Crossheads up		
New Parts Delivered to Shop			Ash Pans Completed		
Boiler to Boiler Shop			Grates Applied		
Frame to Smith Shop			Smoke Box Fixtures Complete		
Rods to Smith Shop			Tank Ready		
Tank Forgings to Smith Shop			Motion Work Erected		
Brake Rigging to Smith Shop			Valves Set		
Spring Rigging to Smith Shop			Brake Rigging up		
Tank Forgings to Tank Shop			Rods Applied		
Rods Returned to Rod Shop			Pipe Work Completed		
Brake Rigging to Machine Shop			Lighting Equipment Applied Complete		
Spring Rigging to Machine Shop			Engine Painted		
Frame to Machine Shop			Engine and Tender Out and Coupled		
Driving Box Brasses Pressed in Box			Engine Fired		
Spring Rigging to Floor			Safety Valves Set		
Brake Rigging to Floor			Air and Steam Heat Completed and Tested		
Shoes and Wedges Laid out and Sent to Machine			Engine Broken in or Whiteleaded		
Frame Binders Closed					
Frame to Engine					
Frames Applied					
Boiler Returned to Erecting Shop					
Cab Work Complete and Ready for Test					
Flues Applied to Boiler					
Firebox Work Completed					
Boiler Ready for Hydrostatic Test					
Frames Bolted Complete					
Engine Truck and Trailer Completed					
Booster Work Completed					
Wheels Ready for Engine					
Driving Boxes Ready for Engine					
Rocker Boxes Refitted					
Shoes and Wedges Planed to Marks					
Frame Binders Refitted					
Spring Rigging Applied					
Boiler Lagged					
Jacket Applied					
Cylinder Work Completed					
Tank Cistern Completed					
Running Boards up					
Cab on and Floor Applied					

______ SCHEDULING DEPARTMENT

Fcrm of report made by the scheduling department showing actual progress of work compared with scheduled progress

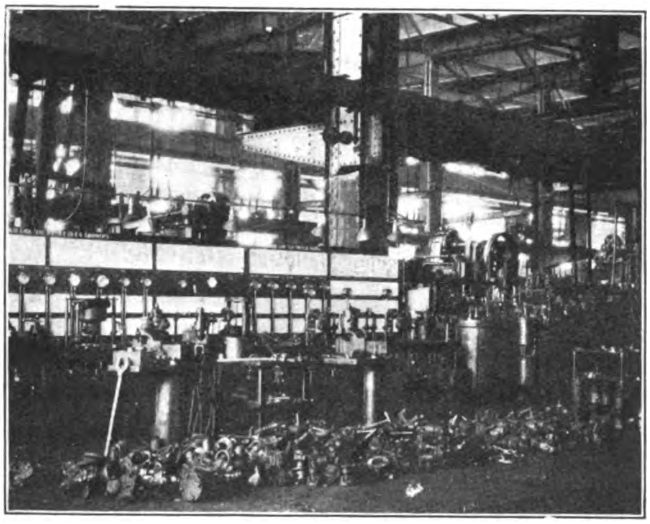
plenish stock at Sayre, but at other points on the Lehigh Valley as well. These requisitions are forwarded to the Sayre storehouse, and then to the division accountant's office where a shop order is made out and a number assigned. The shop order is sent to the stores department where it is recorded and is then sent via the shop superintendent to the foreman concerned. When the order is completed, the foreman enters the time and material charges on the order form and returns it to the shop superintendent. The storehouse is then notified that the order is completed and is located at a certain material station. The delivery man then notifies the truck driver who collects the material on the next trip and delivers it to the proper department in the storehouse. The order form, with the time and material charges entered thereon, is returned to the division accountant for his information.

The proper time charge is determined from records maintained by the supervisor of shop costs who reports



Sketch showing the arrangement of the injector test rack

to the shop superintendent. Time studies are used to establish piece rates. These studies, which are being made constantly, consist essentially of checking the same operations by different men on different machines and then taking the average. They are repeated after the foremen and men have had an opportunity to cut the time down. The rate is finally set by the study of the job from records taken by the time study man. Time



Interior view of valve repair department showing the air brake test rack

wasted due to improper organization of the work is considered and is either left out or in, or partly out, according to the circumstances surrounding the work and the nature of the job.

A record is also kept of the utilization of machine tools in each department. This is accomplished by means of a mimeographed report form which is filled out by the piece-work inspector, with the assistance of the depart-

ment foreman, and forwarded to the schedule office. This report shows the number of the machine, the operator's check number and the causes of the machine being idle. This report is signed by the piecework inspector and checked by the department foreman.

Locomotive shop maintains good production

The locomotive department employs approximately 850 men, which includes those employed in the blacksmith shop, power house and those employed as supervisors. It has an output of one locomotive every 4½ shop hours in addition to the large amount of manufacturing work it performs for the entire system. About 400 men are employed in the erecting department which is divided into two bays, one on each side of the building.

Adequate facilities, a description of which was included in Part I, are provided for handling the work in the erecting shop. Efficient crane service permits the prompt moving of parts to and from the lye vats and the handling of lubricators, injectors, etc., to the proper department for repairing and testing. All work of this nature, including air brake valves, steam and air gages, safety valves, etc., is performed in one department located at the southeast end of the machine shop. The locations of the various machine tools, test racks, special benches, etc., are shown in the drawing of the floor plan of the locomotive shop included in Part I.

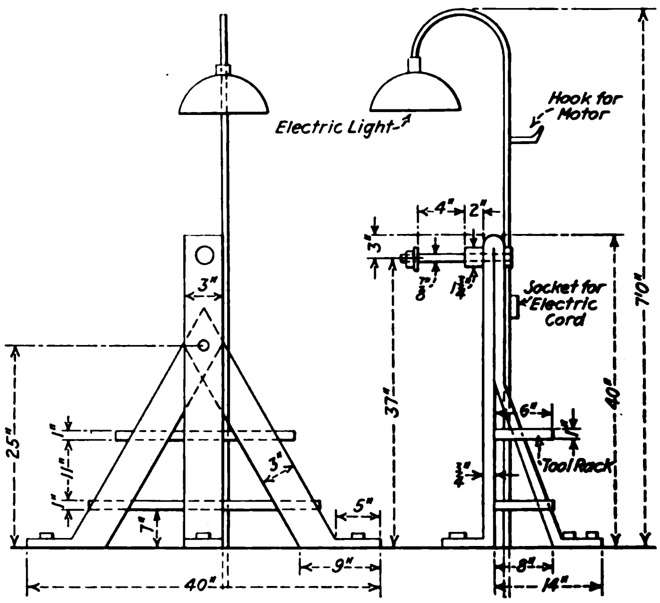
The air brake test rack, shown in one of the illustrations, is designed to test all locomotive air brake equip-

Looking down the machine shop bay from the rod department

ment in strict accordance with the Westinghouse code. Tests are provided for H-6 brake valves, independent brake valves, distributing valves, G-6 brake valves, plain triple valves, brake pipe vent valves, auxiliary device governors, bell ringers, feed valves, signal valves and signal equipment. A rigid test is provided for all slide valves, graduating valves and piston ring leakages, also the frictional resistance of equalizing pistons is registered. The section of the test rack provided for feed valves is so constructed that three valves may be tested simultaneously. The other part of the rack is arranged so that each appliance can be completely tested independent of all other devices; or the equipment of the entire test rack may be operated and tested as a unit, by operating certain by-pass valves.

Westinghouse charts of the ET equipment and printed copies of the Westinghouse test codes for the brake and signal equipment are located on the back of the test rack as a guide for the operator. The air used for operating the test rack is supplied from the shop air line through a booster pump located at one end of the rack which assures an adequate supply of air at all times. An Eastman timer is provided for timing purposes in testing the different appliances.

Special equipment is provided for repairing and testing



Sketch of the injector repair rack

injectors. The repair rack, shown in the sketch, is constructed of 3-in. by ¾-in. iron bar. Two racks are provided for tools and also a hook on which to hang the air motor used for reaming, etc. The ⅞-in. bolt is inserted through the bolt hole in the body of the injector provided for securing the injector to the boiler. The injector can be clamped in any convenient position by merely tightening the nut on the bolt. This rack is suitable for practically all types of locomotive injectors commonly used.

The use of the injector test rack, also shown in one of the sketches, eliminates considerable time and trouble in having to wait for the locomotive to be fired up. Referring to the sketch, it will be noted that the conditions for tests are practically the same as those met with in actual service. The supply pipe leads from an open tank and the water is delivered against pressure which is regulated by a control valve. Gages are provided for ascertaining the pressure of the water in the delivery pipe and also for ascertaining the steam pressure used in creating the water pressure in the delivery pipe. If the water pressure exceeds that of the steam pressure by a certain amount, the injector is marked O.K. for service. Both the repair and test racks were developed by members of the Sayre shops organization.

The machine shop

The various departments of the machine shop are arranged in logical order through the center of the locomotive shop building according to the character of work performed. A drawing of the floor plan of the locomotive shop showing the location of the machine tools

and shop equipment, together with a list of the equipment, was included in Part I. Approximately 300 men are employed in the various departments of the machine shop a portion of whose time is devoted also to manufacturing work. The entire machine shop is in charge of the general machine shop foreman, with one machine foreman assigned to each side.

An automatic turret lathe department located adjacent to the valve repair department produces finished parts in quantity for stock, such as, studs, taper pins and bolts, valve spiders, small bushings, journals, grease cups, etc. Many of the parts produced in this department are used by the valve repair department in the repairing of air brake valves, etc.

The utilization of automatic and semi-automatic machine tools is a considerable factor in obtaining efficient utilization of man power. One man for example, performs the work of drilling pistons and crossheads, and also operates an automatic machine for milling keyways in crossheads and piston rods. Another case is that of one man being assigned to two lathes, one for finishing wrist pins and the other for finishing piston rods.

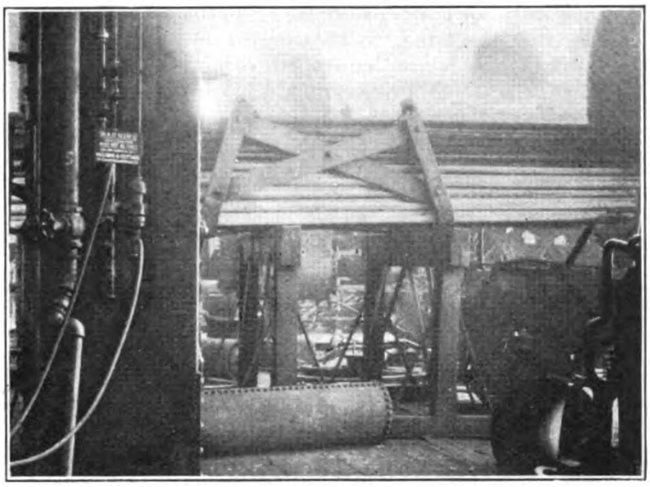
The wheel shop is provided with two vertical boring mills; namely, an 84-in. and 72-in., both of which are motor driven, for turning tires and wheel centers. One mechanic and a helper removes all driving wheel and trailer tires, turns and shrinks them on the wheel centers. It is also the practice to keep an extra pair of booster wheels on hand at all times to apply when needed.

Shoes and wedges are planed to line, driving boxes paralleled aand crossheads are planed on a 32-in. planer. Crank pins are turned and finished on a 36-in. lathe equipped with a shop-made turret that holds four tools, a roughing tool, a finishing tool, an end tool and a roller. Cylinders are planed on a 72-in. planer, no chipping is done in finishing a cylinder casting.

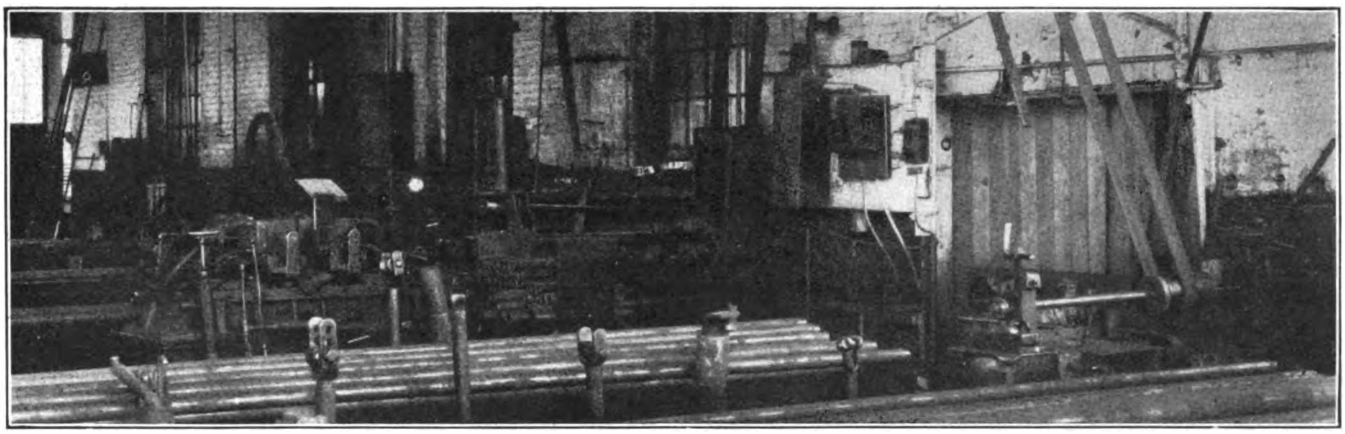
The boiler shop

The boiler shop is located in the end of the locomotive shop building opposite to that in which the valve repair department is located. Approximately 100 men are employed in this department. The location of the boiler repair work at one end of the building facilitates the routing of the work by crane direct to and from both erecting shops. A separate department is maintained for the repair of superheater units, the location of which is shown in the floor plan drawing of the locomotive shop included in Part I. The boiler shop also has its individual tool room which issues and maintains all the small tools incidental to boiler repair work, such as air motors, riveters, staybolt taps, etc. A 15-ton hydraulic gap riveter greatly facilitates the work of riveting seams in the barrel of a boiler. This riveter is located so that it can be served by an overhead travelling crane, which is used for up-ending the boiler and holding it in the riveter.

The work of tapping staybolt holes in fireboxes is speeded up considerably by having two men work together, one inside the firebox and the other on the outside. Instead of reversing a tap and backing it out of the hole, the tap is run entirely through the hole, and is taken by the man on the opposite side and returned through another hole in the same manner. With this system, two taps and two air motors are kept in practically constant operation and no time is lost in backing out the long taps. An unusually high standard of workmanship is maintained in the boiler repair work, not only in riveting joints, but also in welding.



Flues are removed from a boiler and taken to the flue shop by crane and truck—An outlet for acetylene welding is shown at the left



Interior view of the flue shop

Welders are required to make six test pieces every three months. These are sent to Packerton, Pa., for test. If these test specimens do not meet requirements, the welder is given further instruction and is only permitted to do certain kinds of work until he qualifies. Test pieces are made from 3/8-in. or 1/2-in. boiler plate and the weld must withstand a tensile stress of at least 75 per cent better than the allowable tensile stress for the plate itself. This method of examination of the welders has resulted in a high standard of workmanship. Out of a recent lot of 50 test pieces, 47 welds were as uniform as

the plate itself, while three were under the required tensile stress.

The flue shop

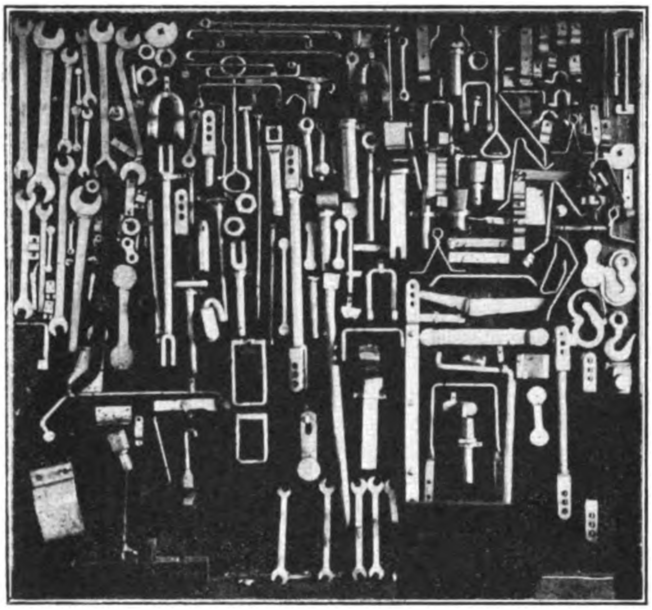
The flue shop is in a separate building 62 ft. wide by 182 ft. long, and is located southwest of the assembly hall. This location makes it comparatively easy of access not only from the locomotive shop, but from the enginehouse as well. Flues are handled by rail truck from the locomotive shop to the flue shop and back. The layout of track for both the locomotive shop and enginehouse permits the flue truck to be easily moved.

The flue shop is well equipped to handle the flue work for both the locomotive shop and enginehouse. The following is a list of the equipment used in the flue shop:

1 18-in. lathe.	5 Flue cutters.
1 Electric flue welder.	4 Air operated flue hammers.
1 Butt flue welder.	2 Flue swedges.
2 Flue testers.	2 Flue rattlers.
1 Turret lathe.	1 Flue roller.

Conclusion

One of the outstanding features in the operation of the locomotive shops at Sayre is the method of handling the work in the blacksmith shop. About 60 men are employed in this shop and it is well equipped with machine tools, etc., for handling a large volume of manufacturing work for the entire system. Examples of various locomotive and car parts manufactured in the blacksmith shop at Sayre are shown in one of the illustrations. Lack of space prohibits the inclusion of a description of the detail operation of the blacksmith shop in this article. A separate article describing the many shop kinks and practices used in the blacksmith shop is contemplated for a future issue.



Display board showing the various kinds of production jobs that are handled in the blacksmith shop

The spirit of co-operation on the part of the men has resulted in many improvements in shop practices that have been a considerable factor in obtaining better production. Practically every man in the shop organization seems to be doing his best to turn out more and better work on his particular job. Many jigs and fixtures not described in this article because of lack of space were originated by the men. Some of these will be described in the future.

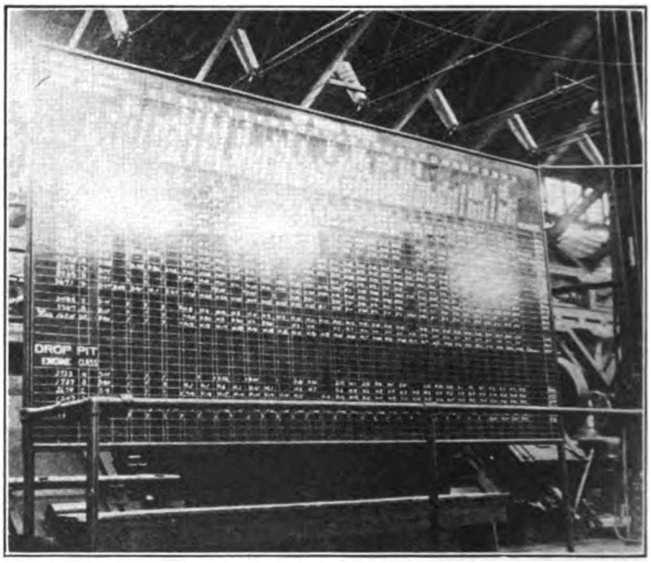
As stated in the introductory paragraphs of Part I, published in the November issue, a large share of the credit for the introduction of the personnel methods not only in the locomotive shops at Sayre, but on the entire Lehigh Valley system as well, belongs to President Loomis. Of course, little could have been accomplished without the earnest co-operation of all the supervisory officers and employees, and to whom a great deal of credit is due for the tactful handling of the initial steps in the starting of the personnel methods as they are in operation today at the Sayre system shops of the Lehigh Valley Railroad.

Master schedule board at Sacramento

By Charles W. Geiger

An interesting feature of the locomotive repair shops of the Southern Pacific, Sacramento, Cal., is the construction and type of the master schedule board, which fills an important function in the scheduling system. The board is located in the erecting shop, central to the other departments, and is mounted on a frame made of pipe, as shown in the illustration. A hand rail is placed around the front to protect the marking on the board. Provision has been made to see that the board is well lighted both day and night.

The schedule dates for all work to be done are shown on the master schedule board as soon as the engine is shopped. In addition to this board, department schedule boards have been placed in the general foreman's office, boiler, tank, blacksmith and machine shops and other departments which are concerned with locomotive repairs. These department schedule boards are of considerable assistance to the foremen as it makes it unnecessary for them to leave their departments to see how their work is coming along or to hurry the foremen of other departments for material. The schedule dates when once set are not changed and it is necessary for each department to have its work completed and ready for the locomotive repair shop on the day indicated on the schedule board.



The master schedule board of the locomotive shops of the Southern Pacific, Sacramento, Cal.

Dependable method of setting Walschaert valve gear

Simplified by predetermining and maintaining the proper lengths of the various rods

By L. V. Mallory
Gang foreman, Missouri Pacific, Kansas City, Mo.

THERE are many methods of setting the valves of locomotives using the Walschaert valve gear, and in practically all, the changes required are determined from the tram mark readings on the valve stem. Usually, by these methods, the lengths of either or both the radius and eccentric rods are altered to equalize the valve travel. In a great many cases, the radius rod length is changed without considering the fact that it should have but one length to insure that the valve will have equalized travel at all points on the reverse lever quadrant. In many cases, no doubt, the reader can recall where a locomotive would tram square

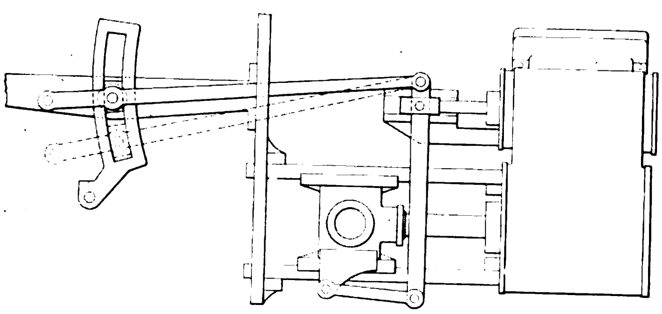


Fig. 1—First step in checking the radius rod for its correct length

at the position the reverse lever was setting when the valves were set and yet would be out when working on an increased or decreased valve travel.

The name radius rod should suggest the reason for this. By asking this question, "Does the center to center length of the radius rod maintain a true radius with the link curvature when changed to obtain the apparently correct valve stem reading?" will bring home the importance of maintaining the correct lengths for radius rods.

In the following paragraphs will be outlined a method of setting the Walschaert valve gear wherein the radius rod, the union link and valve stem lengths are predetermined, leaving only the crank arm location and eccentric rod length to be determined at the final "runover."

Determining the correct length of the radius rod

By referring to Fig. 1, it will be noted that the crosshead, union link, combination lever, valve stem and radius rod are all connected in their regular manner, leaving the eccentric rod disconnected at the link. The correct length of the radius rod may be determined after the cross head has been placed near the center of its travel.

By passing the radius rod from the top of the link downward past the center, the valve will move to a position (if the radius rod is of the correct length) which will form a true center for the link radius when the link is in its central or neutral position. By securing the valve stem in this position and passing the radius rod down to the bottom of the link slot, will hold the link in its neutral position.

To determine the correct length of the radius rod, lock the link, as shown in Fig. 2, in the position it is now held. A pair of small jacks similar to those used in laying off shoes and wedges may be used for blocking the link by placing them between the link and guide yoke. With the valve stem still locked, disconnect the union link from the combination lever leaving the latter free to swing. Now with a small tram, swinging from the center of the front radius bar pin, scribe a line on the valve stem gland, then swing the radius rod upward to the top of the link slot and again scribe a mark with the same tram. If the radius rod is of the correct length, the tram will trace the same line made while at the bottom of the link. Should this second mark fall behind the first one, it indicates that the radius rod is too short and should be lengthened one half the distance

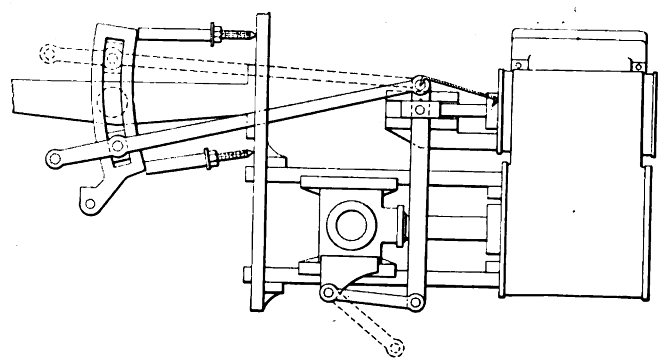


Fig. 2—Second step in checking the radius rod for its correct length

between these two lines. If the second line falls ahead of the first, it indicates that the radius rod is too long and should be shortened one half the distance between the two lines.

After correcting the radius rod, if necessary, to the proper length, place it at the exact center of the link, release the locked valve stem and proceed to take the port opening marks in the usual manner, moving the valve as desired by swinging the free end of the combination lever. Accurately divide the distance between the port marks and make a central mark, after which move the valve with the combination lever until the port mark tram falls in this center line and then lock the valve in this position. This step is shown in Fig. 3.

How to determine the union link and valve stem lengths

The next step is to determine the union link and valve stem lengths. This is done by dividing accurately

for a central mark *C*, Fig. 4, between the striking points on the main guides. The crosshead is then placed on the central mark *C* and the distance between the lower combination lever pin center and the crosshead plate pin center is measured. The union link should be corrected to this length, providing, of course, that the position of the combination lever is not too far from the vertical, which indicates that the valve stem is too long or too short.

As there is usually about a 13 to 1 ratio between the path of the valve stem and union link connecting pins of the combination lever, a divergence of ½-in. either way from the vertical as concerns the combination lever, when measured at the bottom hole, could be made with-

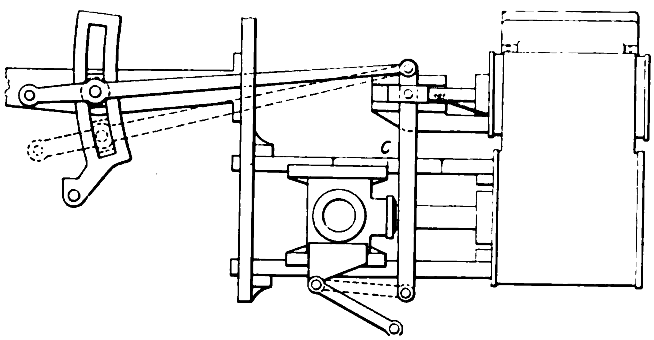


Fig. 3—Taking the port marks and determining the correct length of the union link

out any bad results. This gives a 1-in. margin to work in as concerns the union link before an alteration of the valve stem length should be resorted to. For example, a 1/32-in. change in the valve stem would avoid a 13/32-in. change in the union link. But as it usually calls for the removal of the valve to make a valve stem change, it is more practical to make the correction in the

in the eccentric rod when the locomotive is "run over."

This is done by simply dropping the radius rod from the center of the link, as shown in Fig. 3, to the bottom of the link, Fig. 4. The pin is placed so that it connects the eccentric rod with the link in its hole with the head out. This affords a center from which to tram, using a tram of sufficient length to reach a point near the center of the cylinder jacket. A vertical line *O*,

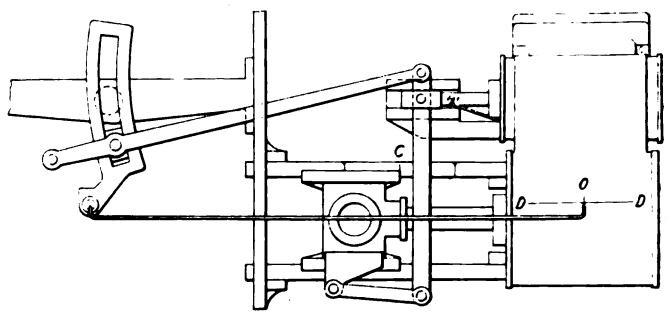


Fig. 4—Locating the link dead center mark

Fig. 4, is scribed in such a manner that it will be bisected by the line *DD* which is scribed on the cylinder jacket parallel with the piston rod and at a distance above the piston center so that the link foot pin is located above the piston center line *C*. The crosshead, main road, eccentric rod and the link and crank arm can now be connected, the valve stem crosshead, of course, being released. We are ready for the final valve "run over" which will determine the length of the eccentric rod and the location of the eccentric crank arm.

The final valve "run over"

In the procedure of running the engine over a live engine or a transfer cable is used to move the engine continuously but slowly forward. While the engine is

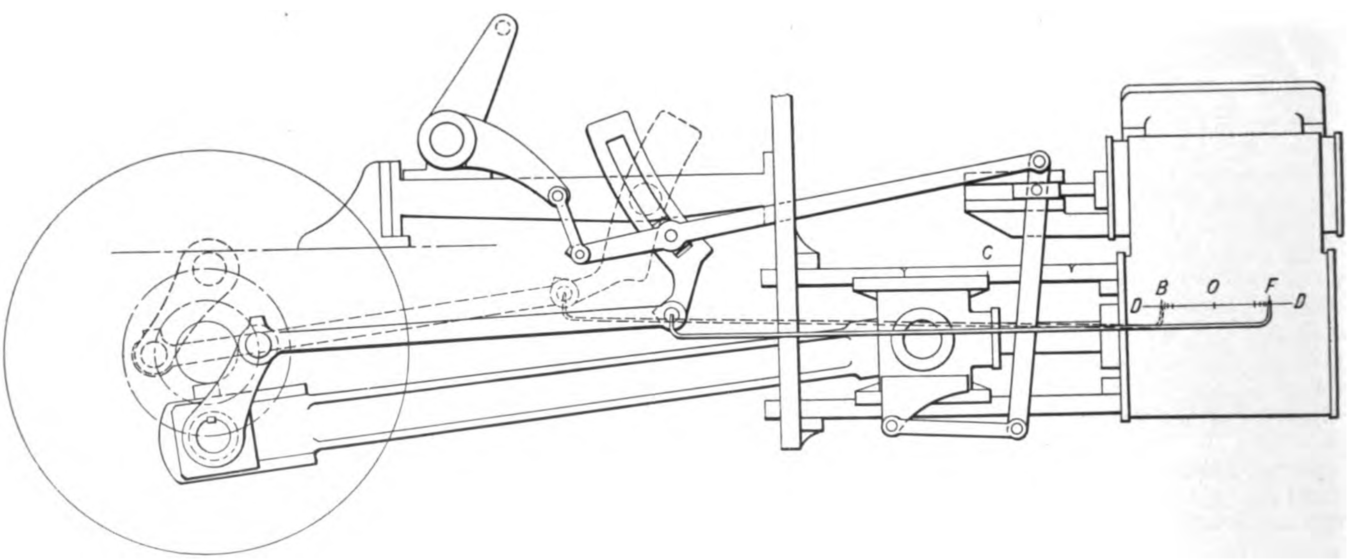


Fig. 5—Running the engine over to determine the correct location of the crank arm and correct length of eccentric rod

union link as long as the valve stem does not vary over 1/16 in. from the standard length.

Assuming that the union link and the valve stem have now been corrected so that the union link will readily connect with the crosshead and combination lever while the crosshead and valve are still in the same positions shown in Fig. 3, we are now ready to locate the link dead line or neutral mark on the cylinder jacket which will simplify matters in determining the change required

being moved, one end of the same tram that was used in locating the dead mark in Fig. 4 is hooked in the link-leg pin center and its scribing end is just above the line *DD* on the cylinder jacket, as shown in Fig. 5. The scribing end is allowed to travel along in this manner for a little over one full revolution of the crank pin. This determines accurately the crank arm pin throw. Compare the length of this line thus scribed with that of the throw required in the builder's specifications. Of

course, the center to center length of the crank arm must check up accurately with the standard blue print when using this method. If they agree, it indicates that the eccentric crank arm is correctly located on the main pin.

If the line scribed by the tram is longer than the required throw, it indicates that the crank arm pin is too far out from the center of the axle and should be swung toward the center until it gives the required travel. If this eccentric throw line is shorter than the required throw, it indicates that the crank arm pin is too close to center of the axle and should be swung out to correct the error.

For example, the required throw for the locomotive is 18½ in. and the scribed line measures 18¾ in. To correct, it is necessary to swing the crank arm toward the center, one half the difference between 18¾ in. and 18½ in., which would be ⅛ in. If the keyways of the crank pin and crank arm don't line up with each other when thus corrected, the key must be offset to suit.

If the crank arm location checks up correctly the correct length for the eccentric rod can be readily determined by finding the exact center of the throw line, scribed by the tram when the engine was "run over," and compare it with the dead line *O*. If the eccentric rod is correct in length, the center of the throw line will fall in the dead line *O*. If too long, it will fall ahead and must be shortened the actual amount it falls ahead of the dead mark *O*. If too short, the throw line center will fall behind the dead mark *O* and must be lengthened in the same manner to correct the error.

If the crank arm location is found to be incorrect, it must be corrected and a new throw line scribed before determining the length of the eccentric rod. This calls for pulling the engine over another revolution. To some of the readers, it will appear that by placing the crosshead exactly midway of its travel, the angularity of the main rod has not been considered and also that by dividing the throw line for the exact center, the angularity of the eccentric rod also has been ignored. But if they will consider the fact that the only time the crosshead has any important relation with the valve, through the combination lever, is when it is at either end of its travel, when the lead opening is imparted to the valve, it thus can be seen that the main rod angularity of the Walschaert valve gear is not as important as in the case of other valve gears. The eccentric rod angularity is overcome by back setting the link foot pin. As long as the links are carefully maintained to blue print measurements no trouble will be experienced from this source.

The link block hanger lengths may be predetermined in the usual manner when using this method, but it need not delay running the engine over as it is immaterial in what position the reverse lever is when using this method as the only time the valve stem reading is considered is when determining the union link length.

This method has the advantages of eliminating the labor of pinching engines over centers, avoiding the confusion in calculating ratios, often experienced when making changes suggested by valve stem readings, and also familiarizing the machinist with the functions of the different parts of the valve gear.

TEXAS & PACIFIC.—A contract has been awarded to the Ware Company, El Paso, Tex., for the construction of a 16-stall roundhouse, steel frame erecting machine shop, blacksmith and boiler shops, brick power house, brick storeroom and office building and several minor structures at Gouldsboro, La., estimated to cost $300,000.

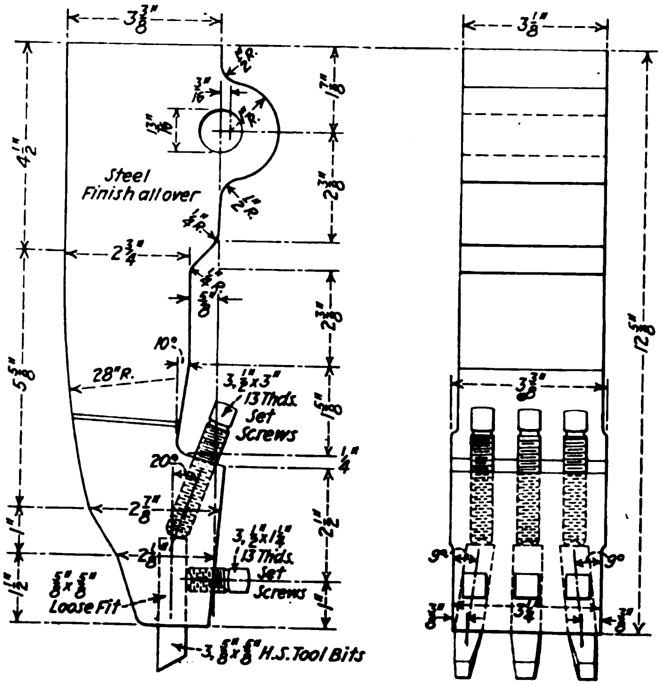
Planing a large main rod brass

By H. H. Henson

Machine shop foreman, Southern, Chattanooga, Tenn.

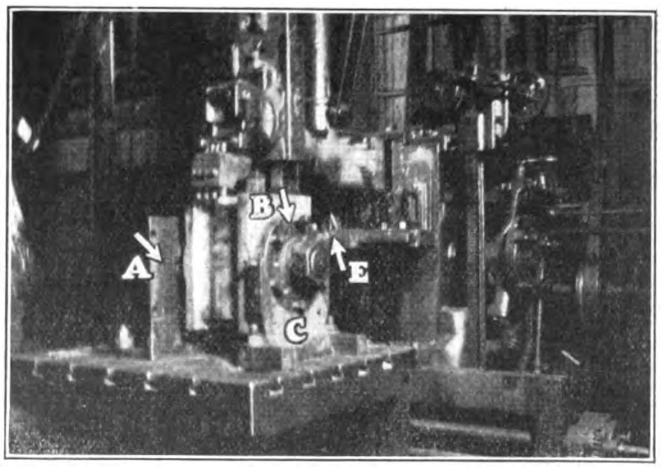
THE accompanying illustration shows how a large back end main rod brass is planed with a gang tool in one hour, using a Morton draw-cut shaper to operate the tool.

The brass is fastened in a swivel chuck *A*. This chuck is easily constructed as it is made of an ordinary angle



The design of the gang tool for planing main rod brasses

plate that has eight spaces equally divided and slots cut for a dowel key to hold the brass at every ¼ and ⅛ position. The chuck is secured to the shaper table by means of bolts and a key fitted to the slot in the table of the shaper and the angle plate. This key insures the proper alinement of the angle plate to the shaper ram.



The gang tool and brass in place on a shaper

The collar on the end of the mandrel is tightened by a large hexagon nut after which set screws in the collar are tightened to secure the brass so that it will not move. The steady rest *C* is placed under the collar *B* and fastened to the shaper table with bolts. The sup-

port *E* is then placed in position between the brass and the shaper which gives the brass a firm support.

Particular care must be taken in grinding the cutters and setting up the shaper. The tool is placed in the clapper box or the tool post head of the shaper after the regular tool post has been removed. The production of this tool depends on the will of the operator to keep it in working condition.

One method of laying off shoes and wedges

By W. H. Ohnesorge
General foreman, Boston & Maine, Mechanicville, N. Y.

THERE is scarcely a shop or enginehouse in the country today that is not confronted with the problem of cut driving and trailer tire flanges. Cut flanges, or those worn to the condemning limit of thickness or worn vertical, are caused by the wheels not running perfectly square or at right angles to the frame.

Many shops, in laying out their shoes and wedges, use strings through the centers of the cylinders extending to the rear of the locomotive frames. A straight edge is then placed against the shoe side of the main pedestal jaws, and a straight edge squared to the cylinder lines. If the straight edge, when placed against the jaw faces, does not show a right angle, the straight edge is moved far enough from the jaw face on one side to divide up the difference, after which the main, or initial starting point in laying out shoes and wedges is marked off on the frame by placing a square on top of the frame and with the blade of the square against the straight edge, a line is drawn on both frames.

There are a number of factors that must be considered in getting the main centers when using this method. The lines through the cylinders are centered with a pair of inside calipers measuring from the cylinder head counterbore in front of the cylinder to the line, and from the piston gland stuffing box in the rear cylinder head to the line.

Unless the mechanic is very accurate in centering the lines, they will not be parallel with the frames. He must use a good linen or silk line and the caliper leg should touch the line just so it can be felt with the calipers. Otherwise, if he calipers a little heavier on one side of the line than on the other, his line will vary greatly, depending on the length of the frames.

When the mechanic moves his straight edge away from the jaw face in order to square it with the cylinder line, he creates the first error towards cut flanges. The position of the straight edge, after squaring it with the cylinder line, is to be the position or angle at which the driving wheels will be set when under the locomotive, or, in other words, the wheels on one side of the locomotive will be running ahead of the wheels on the opposite side, with the result that the side running behind will have the flanges rubbing the rails, which causes cut flanges.

After such a locomotive has run 1,000 miles, the inspector reports flanges cutting on one side. The enginehouse foreman is then compelled to pull down all the shoes and wedges on one side and either line all the shoes to throw the drivers back onto the side not cutting, or plane off on the shoes on the side having the cut flanges. After making the changes, the drivers are then running square with the frames instead of parallel with the cylinders.

The writer is a firm believer in the fishtail tram method of getting the main centers from which to work. By placing a stick between the frames just back of the cylinders and measuring the exact center between them, then marking this center on the stick, the machinist has the first center from which to work. He then uses a tram rod having one tram point which is adjustable. The end of the tram rod has a pointed end which is inserted in the center on the board between the frames. The adjustable tram point is then used to scribe a line either inside or outside on the frame legs at some point near the main jaws. The marks scribed on the inside or outside of the frames should be made on the jaws on each frame without altering the distance between the tram point and the end of the rod, so that each line scribed will be the same distance from the center just back of the cylinders.

If, on account of the frame spreader castings or braces interfering so that the main centers cannot be reached, this line can be scribed on any of the jaws and the line transferred back to the main jaws with the tram rod.

If the lines are scribed on the inside of the frame jaws, a straight edge is used for transferring the lines to the outside of the frame, setting the straight edge at an equal distance from both the marks. Then with a tee-square over the frame and the blade against the straight edge, the line can be drawn on the upper part of the frame at the jaws, for the initial point to work from. The cylinder line can be used to determine if the spreader castings are holding the frames parallel throughout their length, measuring from the cylinder line to each jaw. If the frames are buckled, they should be pulled together or spread at different points to bring them parallel with the lines. If the frame does not measure the same distance from the lines to the frame jaws and the frames cannot be drawn in or out to make them parallel, an allowance should be made for lateral thickness on each box jaw where the variation occurs so as to keep the wheels in proper alinement. By doing this excessive friction on the lateral faces of the driving boxes will be prevented. Allowances should also be made for variations in the thickness of the hubs.

Cylinder lines should not be used in getting the main centers to work from in laying out shoes and wedges. Where the trailer wheels are held in position in the frame jaws, the center of the jaws should be trammed from the center of the back driving box centers so that the trailer wheel centers will be the same distance from the rear driver wheel centers on both sides.

With care taken in laying off shoes and wedges by the fishtail tram method, driving wheel tires will be condemned on acount of tread wear, but not on account of cut flanges and the enginehouse repair men will not be required to pull down the shoes and wedges to throw the drivers ahead or back to make them run square with the frames.

Driving boxes should always be bored central, or the bore of the brass should be an equal distance from the shoe and wedge faces. The rod should be trammed to blue print length, using the centers in each rod. If the rods do not tram up correctly or correspond to the length shown on the blue print, they should be altered so that when the rod bushings are pressed into the rods, the lengths will be correct.

After the wheels and the shoes and wedges are in position under the locomotive, the wheels should be trammed from one center to the other to determine if any errors have been made when the shoes and wedges were laid off. If the distance between the centers varies over 1/64-in., the shoes and wedges should be lined ahead or back so as to bring all wheel centers in tram. Never change the rod lengths to compare with the centers between the drivers. Change the shoes and wedges.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Question—Straightening long reamers

NEW YORK.

TO THE EDITOR:

After the toolroom has completed the machine work on reamers, they are sent to the blacksmith shop for hardening. These tools, which are made from axle steel, are hardened by packing them in carbonizing material, heated for eight hours at 1,550 deg. F. and then left to cool overnight in the packing pot. They are again repacked in the same material, heated to 1,550 deg. F., held at this temperature for seven hours, and then removed and quenched in salt water. They are then heated to 400 deg. F. in an oil vat, where they remain for four hours.

Ordinarily, no trouble is experienced with small reamers, but when working with reamers ranging in length from 12 in. to 27 in. and in diameter from 1¼ in. to 1⅝ in., considerable trouble arises from warping. It is then necessary to straighten them. Our practice has been to heat them slightly and then attempt to straighten them. This method has not been very successful. I would be glad to read of the practices followed by those who have been successful in straightening long reamers.

A BLACKSMITH FOREMAN.

Axle failures in cold weather—A question

CLEVELAND, Ohio.

TO THE EDITOR:

Mr. Litchfield states in his article on axle failures in cold weather published in the August issue of the *Railway Mechanical Engineer,* that "There is no such thing as crystallization of steel caused by long continued service." He then explains that the failures may be attributed to "fatigue" or "cleavage."

I would be very much interested in knowing the nature of this cleavage. Does an actual crack develop gradually which can be detected by white lead or is the trouble microscopic? In either case will annealing restore the original condition?

This question is often raised in regard to rod failures. We continue to anneal drawbars and other parts to "restore their life." Is this beneficial?

JOHN E. KLOSS.

The Answer

NEW YORK, N. Y.

In replying to your question I would say that the nature of cleavage in axles which have failed from repeated strains is an actual crack which develops gradually and which occasionally can be detected by examination of the surface with a high-powered magnifying glass. Ordinarily, however, the crack is not so discernible but it can be made to show up by soaking the axle in oil for some time, then wiping the surface clean and coating over with whiting and finally giving the axle a sharp blow with a heavy sledge hammer. As a result of this hammer blow the oil which has gradually worked its way into the crack will ooze out to the surface showing a distinct hairline in the whiting. The same character of failure has often been observed on other parts besides axles and as the failure ordinarily is a well defined gradual crack, I do not see that there is anything to be gained in such cases by annealing the parts at intervals during service.

NORMAN LITCHFIELD.

Carry on

TO THE EDITOR:

MINDEN, La.

There's romance in a railroad job
  To one with eyes to see,
With heart and mind anent the work,
  What e'er that work may be.
To watch the clock hands 'round the dial,
  One's peace of mind despoils
And proves the adage oft retold:
  "A watched pot never boils!"

The importance of the work you do
  May look like thirty cents.
Yet, any job's worth doing right,
  On a Pullman or a fence.
'Tis true, anon someone gets by
  Sans sweat upon his brow.
He fools no one, except himself—
  That's easy anyhow.

The biggest engine on the road
  Would never move our trains,
No matter what her tractive force,
  If uncontrolled by brains.
No single mind could turn the trick,
  Your job, however small,
Neglected, were perhaps the one
  To make that engine stall!

Just think the job you have at hand
  Is worth the doing well.
If a line be drawn, hew to that line,
  Let chips lie where they fell.
A railroad ladder has no top
  Nor fixed rule how to climb.
Things, big or small, must be well done
  If trains are run on time.

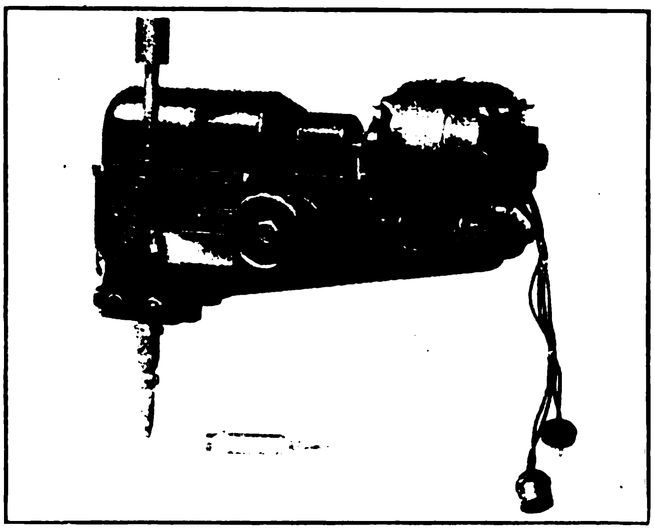
To be a college man or not,
  Won't keep one out of ruts.
No job is ever out of reach
  Of the man who buts no buts.
Nor does one ever get as big
  As being the whole show.
Success, for him, lies in the goods
  Delivered from below.

J. B. SEARLES.

Automatic arc welding head

AN AUTOMATIC arc welder, designed to weld with smoothness, speed and accuracy, has been introduced by the General Electric Company, Schenectady, N. Y. With this equipment, the operator pushes a button to start the sequence of operations which produce the weld without any further effort or skill on his part. The welder starts the arc by first touching the electrode to the work and then withdrawing it, thereafter maintaining a constant arc length by feeding the electrode wire to the weld at the exact rate of speed necessary to replace the electrode fused into the weld.

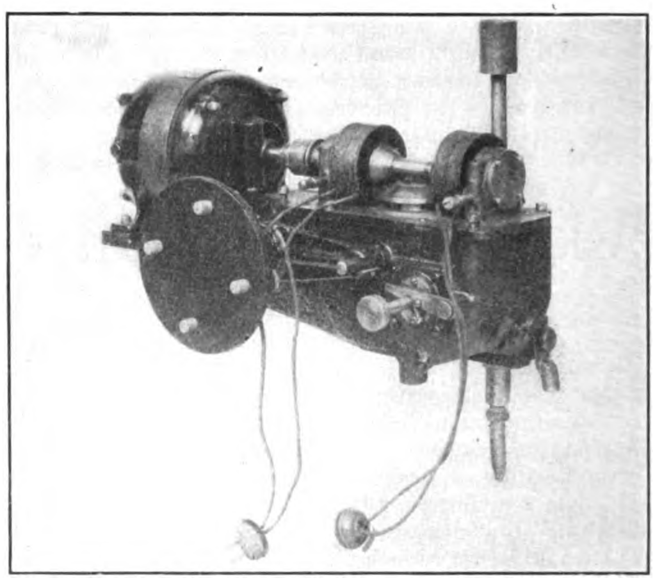
The automatic welding head incorporates the necessary mechanism for feeding the electrode to the arc, and consists essentially of a pair of feed rollers geared to a constant speed motor through a magnetic clutch. The gearing and feed mechanism are contained in one housing, to which the motor is bolted.



General Electric Type MC automatic welding head

The rollers feed the welding wire through the nozzle to the arc. The distance and pressure between these rollers is readily adjustable. Each welding head is equipped with a set of nozzles for 3/32 in., 1/8 in., 5/32 in., 3/16 in., and 1/4 in. wire.

The speed of wire feed may be adjusted by means of a selective gear changer, which permits the gear ratio to be altered at will to adapt the speed of the feed rollers to the size of wire and the welding current used. Three gear speed changes can be made by moving the gear shift pin which extends from the rear of the gear housing. An additional finer adjustment can be made by means of rheostat in the field of the motor. Provision is made for pointing the electrode backward or forward in the line of weld, and also for moving it sideways. The pointing of the electrode is obtained by rotating the head on its horizontal shaft, and the lateral movement by means of the handwheel on the front of the head.



Rear view of the General Electric automatic welding head

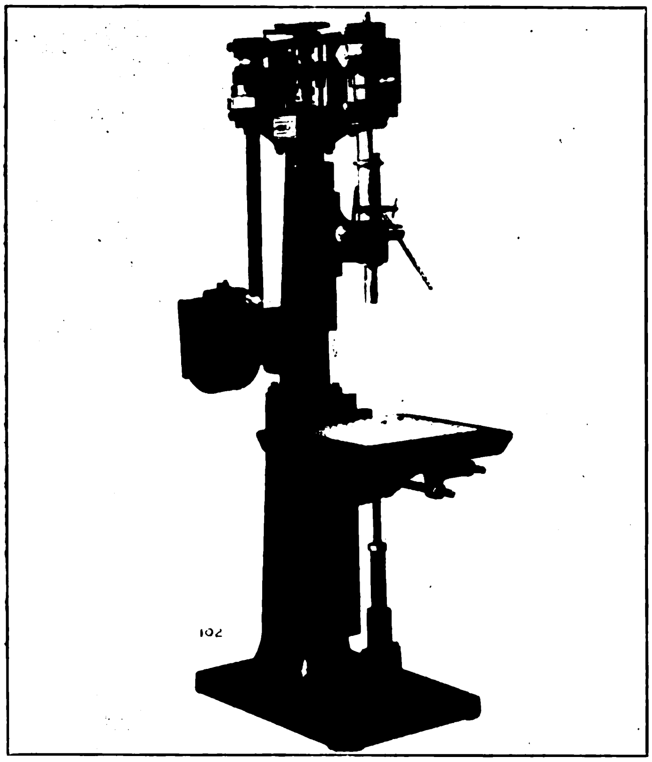
The control equipment consists of a control panel, a meter panel and a push-button station. The control panel mounts the main line contactor for the welding circuit and two smaller contactors for interlocking the travel motor with the arc. By means of auxiliary contacts the line contactor controls the starting and stopping of the feed motor. The magnetic clutch is operated forward or backward by a voltage relay, the coil of which is connected across the arc. Thus the electrode is fed to or from the work automatically, adjusting itself to any irregularities in the surface of the work. One rheostat

controls the speed of the feed motor and the other controls the voltage setting of the arc.

The new automatic arc welder is obtainable either separately (where the user constructs his own clamps) or as part of a complete welding equipment, including necessary clamps and framework for holding the work.

High speed ball bearing sensitive drills

THE accompanying illustration shows the No. 4 high speed ball bearing sensitive drill which, with the No. 3, has been added to the line of drilling machinery manufactured by the Fosdick Machine Tool Company, Cincinnati, Ohio. These machines are built in the single and multiple spindle types, with or without power feed, motor drive, pump and fittings and tapping attachments.


Fosdick No. 4 single spindle sensitive drill

The No. 3 bench-type machine is built with one to four spindles, while the No. 4 pedestal-type can be supplied with one to six spindles. Both machines are built in 16 and 24-in. sizes and have a capacity of ¾ in. drilling and ¼ in. tapping. All revolving parts are equipped with standard ball bearings protected with dust proof metal oil retainers.

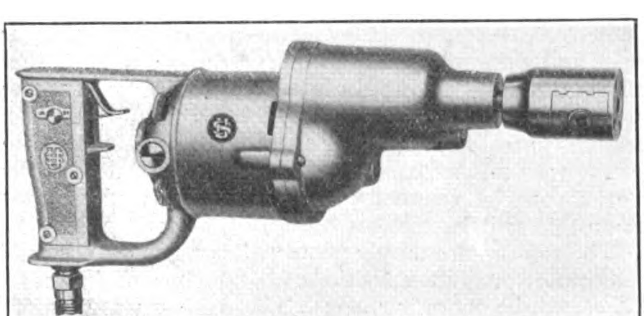
The belt-driven machines are furnished with a tight and loose pulley and swiveling belt guard and shifter. The drive is through spiral gears running in oil. The shifting of the belt on the four step cone is accomplished by means of a central cam drum so that the belt is shifted from one step of the cone before it is advanced to the other cone. Before shifting the belt the tension is taken from the belt automatically by the operation of the idler cam, which releases the tension on the idler. The adjustable spindle collar mounted on the spindle sleeve can be set to disengage the feed at any desired depth of hole drilled.

The tables have a liberal oil channel for chips and lubricant. The No. 4 pedestal-type table is adjustable on the pedestal by means of telescopic screws and can be elevated or lowered and securely clamped with a lever in front of the table. The head is adjustable on the column and can be rigidly clamped in position. The spindle is of high grade spindle steel. The spindle sleeve is of steel and the entire design is built to meet the requirements for rapid and accurate production in accordance with the latest drilling practice.

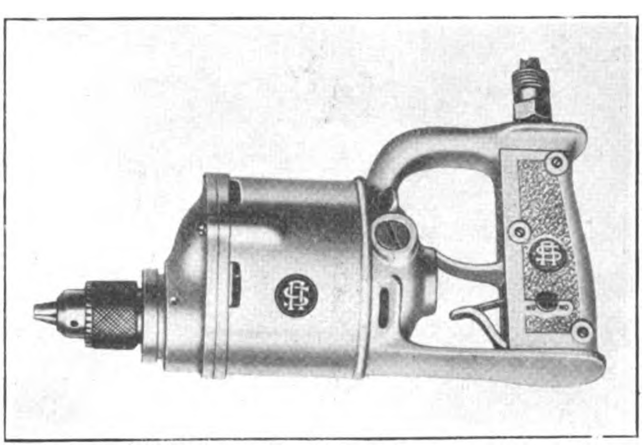
These machines are built under patents.

Portable tapper and heavy duty drill

THE United States Electrical Tool Company, 2488-96 West Sixty street, Cincinnati, Ohio, has recently placed on the market a portable


The chuck of this portable tapper automatically reverses when the operator gives a backward pull on the unit

tapper and a ¼-in. heavy duty drill. The portable tapper which is made in two sizes, No. 1 and No. 2, operates on direct and alternating current. The mechanism in this tapper is so designed that the chuck automatically reverses when the operator gives a backward pull on the tapper. When tapping, this clutch has a


A ¼-in. heavy duty electric drill which has a load speed of 1,500 r.p.m.

positive engagement. When extracting the tap the engagement is by a friction clutch. This feature helps to eliminate tap breakage.

The ¼-in. heavy duty drill is equipped with four S.K.F. ball bearings, all of which are mounted in steel castings. The bearings are placed in the front and back of the spindle, in the handle and in the in and out thrust. A 1,500 r.p.m. motor is used.

Westinghouse box type electric furnace

A NEW box or hearth type electric furnace particularly applicable to the tempering of lathe and planer tools, dies and punches in tool rooms is now being manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

The furnace is constructed of a shell of heavy boiler plate, riveted and bolted to a structural steel frame, and heavy front castings. The heat insulations and the heating chamber are enclosed in the shell. The entire roof is assembled in a frame and bolted to the lower portion of the shell. A feature of this construction is that the roof may be lifted and swung to one side for the inspection or repair of the linings and the heating elements.

The direct radiating heating elements, made of nickel-chromium are protected and open, and are assembled in a frame of the same metal. They may easily be removed if necessary. A cast nickel-chromium floor-plate distributes the heat evenly, protects the bottom element, and forms a smooth surface for handling the material in and out of the chamber.

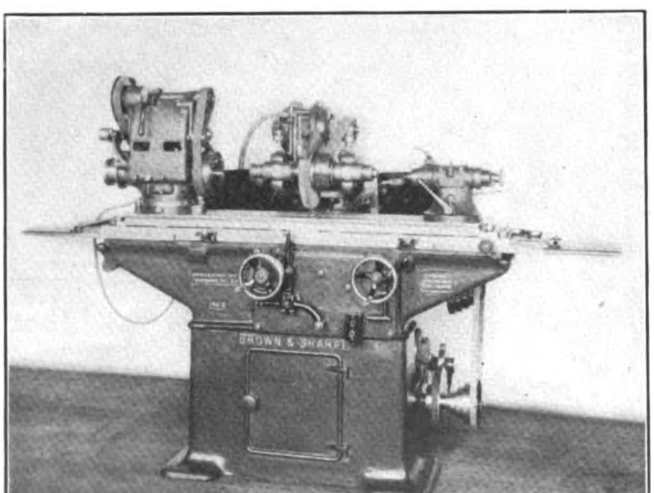
Automatic regulation controls the furnaces within very close temperature limits, which can be fixed as desired up to the limit of 1850 deg. F. This permits economy of operation by eliminating improperly heated charges, and by reducing the operator's time in attending the furnace.

Three sizes are built having capacities, at 1500 deg. F., of 100, 240 and 360 lb. of steel per hour, and with connected loads of 15, 27 and 40 kw. respectively. The smallest size uses single phase, 110-volt current; the middle size, single phase, and the largest size, 1, 2 or 3-phase, 220-colt current.

One of three sizes of the Type H electric furnace

Motor drive for Universal grinding machines

BY MEANS of motor drive, the Nos. 2, 3 and 4 Universal grinding machines manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I., have become completely self-contained and independent units, requiring no more floor space than the same machines when belt-driven from the main line.



The Brown & Sharpe No. 2 Universal grinding machine equipped with three motors

Power for the headstock drive, for the wheel spindle drive and for the table feed drive on each machine, is supplied separately by three individual electric motors. The three motors are controlled by a single push button switch, located at the front of the machine near the controls and within immediate reach of the operator. "Burning out" of the motors through overloading is prevented by means of protective plugs located in the magnetic switch control box, which is mounted on the base casting at the rear of the machine. Any motor not needed may be cut out by removing one of these protective plugs from this switch.

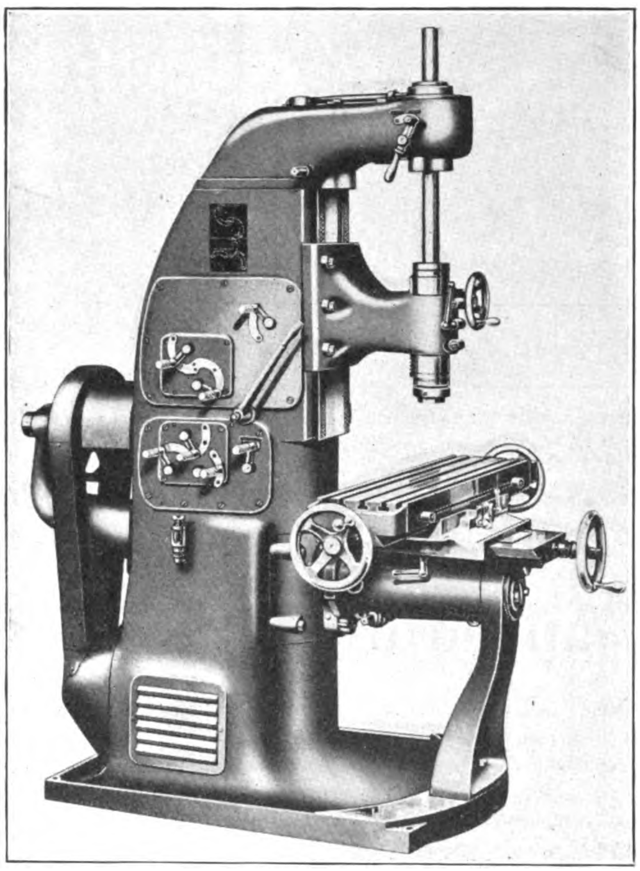
The motors are amply protected, yet readily accessible and in advantageous positions for the efficient delivery of power to the operating parts. The work driving motor is mounted on the headstock which is compactly designed and has provision for driving the work on either live or dead centers by means of an arrangement of belts, pulleys, idlers and belt tighteners. The wheel spindle driving motor is firmly mounted on the wheel stand, and is bolted to the wheel stand platen. The drive is direct from the motor pulley to the spindle pulley, except when the in-

ternal grinding attachment is used. In this case the spindle is replaced by a countershaft through which the drive is taken to the attachment mounted on the platen, which has been placed in the reverse position. The motor for providing power for the automatic table travel and cross feed is located at the rear of the machine. This motor also drives the pump, which provides an abundant supply of water for wet grinding.

Several types of constant speed motors and various types of control equipment suitable for use with direct or alternating currents are offered to meet various installation requirements.

Milling and drilling machine for many operations

MILLING, drilling, boring, shaping and similar operations may be performed with the No. 4 miller now being placed on the market by the W. B. Knight Machinery Company, 3920 Pine street, St. Louis, Mo. Because of its versatility, several operations can often be carried out with one chucking of the work that would ordinarily require a number of machines and set-ups. This machine differs in several respects from former models built by this company. For instance, the machine is of unit construction with a closed column and with one casting replacing several castings used in previous models. Instead of a countershaft drive, the machine is driven by means of a Johnson friction clutch.



The Knight No. 4 miller, designed for milling, drilling and boring

Another improvement is that the knee has a direct bearing on the base of the machine, instead of on the lower end of the column. Also, the table is tilted by means of a worm mechanism instead of by hand. All the gears and clutches are made of heat-treated alloy steel and force-feed lubrication is provided to all gears and bearings within the column. The drive is through a silent chain from a built-in motor in the base. Cutters are held by means of a special adapter collet instead of by a draw-bar. The spindle nose is arranged for imparting a positive drive to the cutters.

The combined column and base casting is heavily ribbed and has large bearing surfaces for other parts. The table unit is arranged to swivel around the column, which considerably increases the range of the machine. The projecting arm on which the knee, saddle, and table are mounted, not only has a large bearing on the column, but is also rigidly supported at the outer end. The knee, saddle and table unit may be tilted around the projecting arm 45 deg. from the horizontal on either side. The degree to which it is tilted is indicated by a graduated segment. When the table is in the horizontal position, a taper pin is placed through the knee and the projecting arm to insure rigidity and alinement.

The spindle head may be raised and lowered by means of a screw, and locked solidly in the desired position. This gives the advantage of a fixed-head construction and also increases the capacity of the machine. The spindle runs in solid bronze bearings, the lower one being 12 in. long and tapered to provide means of compensating for wear.

Both feed and speed changes are accomplished through sliding gear transmissions, so designed that all gears not in use are locked in neutral. The spindle speed gears are assembled in one unit, which is mounted on the left-hand side of the machine, while the feed gears are located in another unit placed directly beneath. The power feed to the spindle is reversible and stops are provided to prevent over-travel of the spindle. The table may be locked for boring operations.

Three hardened and ground steel posts known as "precision locators" may be specially fitted to the machine. These posts adapt the machine for jig boring and similar work requiring accurate spacing and machining of holes. With these posts and the use of a micrometer, vernier or gage-blocks, the operator can quickly and accurately lay out one hole from another.

Whipp open side shaper planer

A REDESIGNED open-side shaper planer which has a more rigid construction than the previous machines and convenient control features has recently been developed by the Whipp Machine Tool Company, Sidney, Ohio. This machine is adapted to the planing of valve motion links and rod brasses.

The base of the new machine is heavy and it has cross ties from wall to wall. A corner brace has also been added between the pad for the column and the adjacent side. The column is a hollow tube with 1-in. walls, internally ribbed and is secured to the base with a large key and six 1-in. bolts. The cross rail is of ap-

proximately box section, is heavy and is arranged to hook around the column in a manner intended to develop its full strength. The saddle and its parts are heavy and in strength are proportional to other parts of the machine.

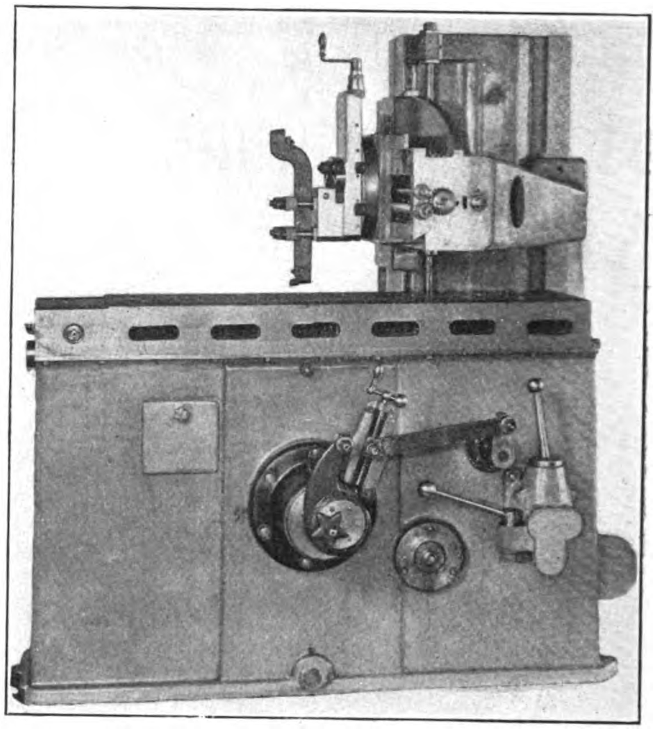
The bull gear is a steel forging and is shrunk, bolted and pinned to the semi-steel center. It weighs 480 lb. This gear has helical teeth of coarse pitch. The gear box is arranged as a unit which may be removed conveniently for inspection. It is oil tight and lubricated separately from other units of the machine.

The table is of box section with twice the depth of the table on the former machines, and it is somewhat heavier. The clutch is of the dry-plate type and is said to be powerful enough to start and stop the machine in the middle of the heaviest cut it can take. A brake is provided with the clutch to stop the table quickly. The vise is of the single-screw swivel-base type and weighs 380 lb.

The gear shift and the start and stop lever are contained in one unit. The feed is adjustable while the machine is running. All controls, adjustments and clamps are arranged so that they may be reached conveniently from the operator's position.

The drive of the machine may be by motor and silent chain or by single-pulley from a line shaft. For the motor drive a 7½-hp. or 10-hp. 1,150-r.p.m. motor is recommended, the smaller motor being for the 26-in. machine and the larger motor for the 36-in. machine. The motor is mounted on a bracket and off the floor and is suitably guarded. Push button control can be had.

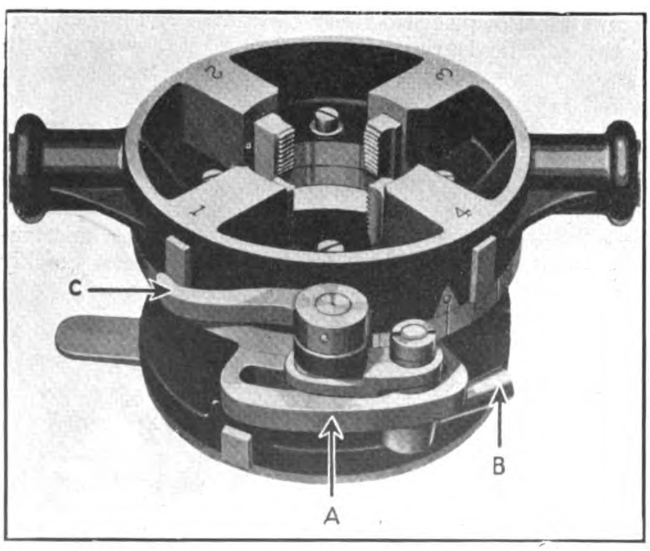
The table travel of the 36-in. machine is 36½ in. The maximum distance under the cross rail is 18 in. The total cross feed is 25 in., down feed, 9 in., and the maximum, horizontal and vertical feed is ⅜ in. and ¼ in., respectively. The table is 62¾ in. long and 17½ in. thick. The height of the table from the floor is 43½ in. Six strokes, ranging from 5.5 to 43 per min. are provided for the table. The net weight of the machine is approximately 7,200 lb.



An open side planer suitable for finishing rod brasses, valve links, etc.

Beaver die stock with an adjustable cam

The feature of the No. 70 series Beaver adjustable die stocks, manufactured by the Borden Company, Warren, Ohio, is that the die adjusting cam is underneath the dies. By this arrangement all obstruction above and around the threading dies is eliminated and the full width of the dies is openly exposed above the body of the tool for the free application of oil. In addition, there is a solid wall opposite, or back of the throats of the dies, which reduces the tendency of dies to tip when pressed against the pipe, and causes them to take hold and start more easily.



The die adjusting cam of the Beaver No. 70 series die stocks, is underneath the dies

The open construction causes chips to fall out and away from the dies instead of to accumulate within the stock. There is free chip clearance around the larger size pipe taken by each tool, as well as around the smaller sizes.

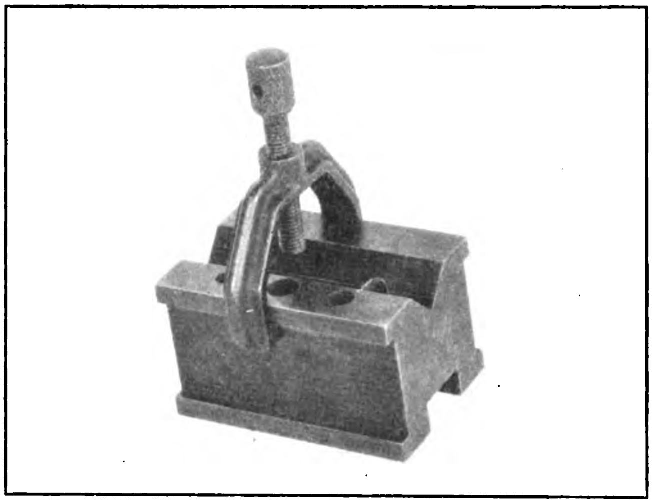
The construction consists of two main parts, a die head and a body casting, between which lies the die cam. Referring to the illustration, *A* is a projecting section of the die cam which is a part of the locking device and also serves as an adjusting handle. The lever *B* clamps the die cam (section *A*) firmly, but, as an added means to insure against slipping, section *A* is tapered and any tendency of the locking device to slip under the strain of threading is more than overcome. Thus the lock is positive, yet quickly and easily adjusted. *C* is a lever with a crank action. Turning this lever to the left opens the dies sufficiently to clear the pipe and saves time and possibly injury to the dies, when backing off over the finished thread; turning it back closes the dies to duplicate exactly the previously cut thread. This is desirable in production work.

Provision is made for the quick changing of dies, without removing any parts and without the aid of tools.

A three-jaw Universal chuck quickly and accurately centers all sizes of pipe within the range of the tool. No locking is necessary.

B. & S. handy block and clamp

An accurately machined and carefully case-hardened steel block with a substantial clamp and screw designed for general usefulness in the garage and shop, has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. It is especially useful in holding small circular or flat pieces while being milled, ground or drilled. Bent rods and

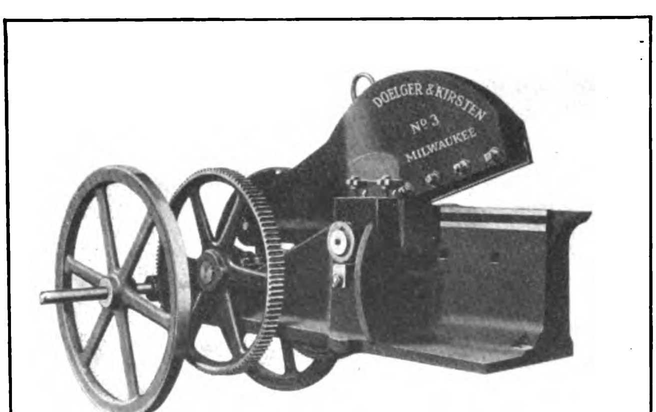


The Brown & Sharpe handy block and clamp can be used for many purposes

flat stock can be quickly straightened with the block, and small pieces, too small for the bench vise, can be filed or center-punched with ease. It is 3 in. long, 1¾ in. high and 2 in. wide. It is capable of holding round stock up to 1 in. in diameter and flat stock up to ¾ in. by 1¼ in.

Milwaukee No. 3 all-steel shears

The Milwaukee No. 3 high knife shear with 36-in. blades, manufactured by Doelger & Kirsten, 3015 Chambers street, Milwaukee, Wis., has been designed to



High knife shear with a capacity of 4-in. round and 3¾-in. square material

shear long sheets, car sides, etc. The jaw, base, gears and pinions are made of annealed steel castings. Owing to the fact that the fly wheels and pulley are subjected to no strain, they are made of cast iron. The shear has double gears and double balanced fly wheels. It is made in the following sizes:

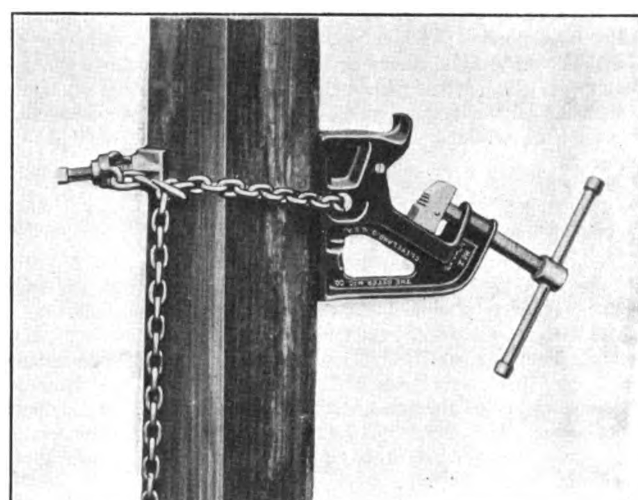
Style number	Capacity	Size of motor	Stationary or portable	Type of knife
1	1½ in. round or square	3 hp.	Both	Low
1½	2 in. round or square..	5 hp.	Both	High
2	3 in. round or 2¾ in. square	7½ hp.	Stationary or on timbers	Low or high
3	4 in. round or 3¾ in. square	15 hp.	Stationary	Low or high
4	5 in. round or 4¾ in. square	35 hp.	Stationary	Low or high
5	7 in. round or square.	75 hp.	Stationary	Low or high

These machines can be furnished either for motor or belt drive. Any of the above sizes can be furnished in the automatic style; that is, fitted with clutches and automatic stop attachments.

Quick acting inclined side-opening pipe vise

The Oster Manufacturing Company, Cleveland, Ohio, has recently placed on the market an inclined, side-opening pipe vise which grips and releases the pipe with one turn of the handle and is said to require less than half the time of the old type hinged vise. It is equipped with oil tempered, tool steel jaws so designed that they will grip the pipe securely without the danger of squeezing it out of round.

A special chain and clamp for fastening the vise to a



The Oster quick-acting pipe vise may be quickly clamped to a post

post are furnished for use where it is not possible to bolt the vise to a work bench. Another useful accessory is a special eye bolt for pipe bending.

The vise will handle pipe from ⅛-in. to 2½ in. in diameter. The jaws will open wide enough to accommodate a 2-in. coupling, so that short nipples can be handled.

Automatic arc welding.—The principles of "Stable-Arc" automatic welding are diagrammatically illustrated in the 24-page bulletin on welding equipment published by the Lincoln Electric Company, Cleveland, Ohio. The carbon electrode process is used with the "Stable-Arc" equipment, a filler rod of mild steel being placed along the seam prior to welding to supply additional metal to reinforce the weld. The time required to make different types of welds on metal of various gages is given in tabular form.

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

First Lieutenant C. F. Parsons, Engineers Reserve, general master mechanic, New York Central, with headquarters at Albany, N. Y., has been promoted to captain, engineers reserve, and is assigned to the 489th Railway Engineers Battalion.

Captain J. G. Hilgen, Engineers Reserve, storekeeper, Chesapeake & Ohio, with headquarters at Richmond, Va., has been assigned to the 568th Railway Engineers Battalion.

New York, New Haven & Hartford.—A contract has been awarded to the J. N. Leonard Company, New Haven, Conn., for alterations to and extension of the car repair shop at the Lamberton street yard, New Haven, Conn., estimated to cost $125,000. This company has also authorized the construction of an addition to the boiler room at Norwood Central, Mass., estimated to cost $27,800.

Frisco reduces hot boxes

The St. Louis-San Francisco established a record on the system in September, 1926, when it made 78,212 car miles per hot box as compared with 17,619 car miles per hot box in September, 1921. The number of hot boxes in September of this year totalled 422 on freight trains and 5 on passenger trains, while in September, 1921, there were 1,200 on both classes of trains. The trains on the system made 33,396,683 car miles during September, 1926, while in September, 1921, they made 21,142,511 car miles.

Advances in wages

The Delaware, Lackawanna & Western, the Lehigh Valley and the Reading have granted increases of pay of two and three cents an hour, to shopmen, carmen, car cleaners and laborers.

The St. Louis Southwestern has granted an increase of 2 cents an hour for mechanics, 1½ cents for intermediate workers, and 1 cent for apprentices and helpers, following a conference between officers of the road and representatives of the Carmen's Association. The increase affects about 400 men. Members of the locomotive department have presented a petition asking for a raise in their group.

Coal in August $2 57

Class I railroads paid an average of $2.57 per ton in August for coal used as fuel for road locomotives charged to operating expenses, according to the Interstate Commerce Commission's monthly compilation of railroad fuel statistics. This compares with $2.65 for August last year. The average cost of fuel oil was 2.95 cents per gallon, as compared with 3.23 cents in August last year. The total cost of coal and oil for the month was $25,272,177, as compared with $26,198,605 in August, 1925. For the eight months ended with August the railroads expended $209,784,721 for fuel for road locomotives, as compared with $213,926,911 for the corresponding period of last year.

Wage statistics for August

The number of employees reported by Class I railroads to the Interstate Commerce Commission as of the middle of the month of August was 1,853,070, a decrease of 4,149 as compared with the number for July. As compared with August, 1925, there was an increase of 52,851. The total compensation for the month was $256,761,368, as compared with $247,071,210 in August, 1925. The report for August includes a chart comparing the trends of the average compensation per employee per hour and the labor expense chargeable to operating expenses per 100 equated ton-miles, from 1916 to 1925. The labor expenses per 100 equated ton-miles is given as follows (in cents): 1916, 27.3; 1917, 29.5; 1918, 42.9; 1919, 49.5; 1920, 58.3; 1921, 57.2; 1922, 51.6; 1923, 48.8; 1924, 49, and 1925, 47.2.

Interchangeability of Miller and G.R.S. train stop

Recent tests made by the New York Central on the high speed tracks east of Cleveland have shown that engines carrying receivers of the Miller alternating current type train stop also function correctly with the inductors of the General Railway Signal Company's auto-manual type. These demonstrations included tests up to full speed for passenger trains through air gaps up to 2½ in. with a lateral offset of 5 in. and another test with an air gap of 3½ in. with a lateral offset of 3 in. The receivers in these cases were 5 in. and 6 in. above the rail level. A test was also made with an air gap of 1½ in. and a lateral offset of as much as 6½ in. The Miller receivers and inductors operate through 6 in. air gaps and comparable lateral offsets. Engines equipped with the Miller apparatus may, therefore, be operated over the Miller type of rail-level integrity-checking inductors on new installations without replacing the present auto-manual inductors now in service on previous adjacent installations on railroads.

Locomotives and freight cars installed

Locomotives installed by the Class I railroads in the first nine months this year totaled 1,664, the Car Service Division of the American Railway Association has announced; an increase of 322 over the corresponding period last year. Locomotives on order on October 1 this year totaled 443, compared with 237. Freight cars installed in service in the first nine months totaled 85,383, a decrease of 28,432, under the number for corresponding period in 1925, and 35,344 under the corresponding period in 1924. This included 8,158 installed during the month of September, of which 3,646 were box cars, 3,313 coal cars and 468 refrigerator cars. Class I railroads on October 1 had 16,846 freight cars on order compared with 21,055 on the same date last year and 49,702 on the same date in 1924. These figures as to freight cars and locomotives include new and leased equipment.

The Lehigh Legion of Honor

This is the name of an honor roll which E. E. Loomis, president of the Lehigh Valley proposes, as a means of giving recognition to the efforts of employees who, by suggestion or invention, contribute to the efficiency of operation of any or all departments of the railroad; action to be based on the decision of a board of officers. President Loomis, explaining the proposition in a circular, says:

"The management values the loyal co-operation of its people and the Lehigh Legion of Honor is intended to give substantial expression of its appreciation of the efforts of employees to do more than what might regularly be expected of them. Nomination for legion membership should be submitted to the president, through regular channels, endorsed by the heads of the proper departments and accompanied by a full explanation of the reasons upon which the nomination is based.

"A certificate of membership and a suitable decoration will be awarded to those selected for the honor. Legion men will be entitled to special consideration in making promotions. Tests are

to be applied to nominees for legion honors by officers of the company, who, themselves, are not eligible for membership; and only those who made a distinct contribution to the success of the company will receive the award."

Special studies for Pullman shopmen

The Pullman Car & Manufacturing Corporation, during the winter months, is giving a course of training in production methods to approximately 1,000 employees in both the Pullman (Ill.) and Michigan City (Ind.) plants. The course is specifically and definitely a car building course based largely upon the experience of the executives of both plants and consists of six units: (1) team leadership; (2) handling men; (3) handling equipment; (4) organization; (5) plant records; and (6) management. Each unit can be read easily in a few hours and is accompanied by a shop problem. Each unit is used as a basis for departmental meetings in which principles are applied directly to each man's work. In addition, a lecture is given in which the principles can be clarified and application to special problems brought out. A general meeting will be held at four-week intervals and these will be supplemented by four smaller meetings. Departmental meetings are held one week before the general meetings.

Pullman employees instructed in first aid

Nearly 600 Pullman Company employees have either received Red Cross certificates for graduation in the first aid course or are now in training. The purpose of the course, which was inaugurated several weeks ago, is to teach men to think in terms of physical suffering, to cause them to view unusual situations in terms of safety, to create a tendency to put one's self mentally in the victim's position and to induce the pupil to study how to keep himself from being involved in an accident; to impel a man to analyze his particular job, and to urge men to take more interest in their physical well-being. A class of 25 safety supervisors, yard men and porters were first given a special course in Chicago, and these men later organized classes in New York, Chicago, Washington, Buffalo and San Francisco.

The course requires 15 hours' time from each pupil; or 1½ hours a week for 10 weeks. The Pullman Company furnishes instructors, material, text-books, etc., free. Technicalities are eliminated and fundamentals only are taught, such as shock, hemorrhage, artificial respiration, mobilization of fractures and the proper ways to lift and carry injured persons.

According to present plans some 600 additional employees will begin a 10 weeks' course after the Christmas holidays.

Meetings and Conventions

Mechanical Division, A. R. A., to meet in Montreal in 1927

The general committee of the Mechanical Division of the American Railway Association at a meeting held in New York on November 18, decided to hold the 1927 annual meeting at the Windsor Hotel, Montreal, Que., on June 7, 8 and 9 with no exhibits of railway appliances or machinery. This decision was reached as a result of an invitation from the executives of the two large Canadian railway systems, which are members of the Association and whose officers have been members of its predecessors since 1867. During the history of these organizations no convention of any of them has previously been held in Canada. The meeting in Montreal next year will coincide with the induction of G. E. Smart, chief of car equipment of the Canadian National, now vice-chairman of the division, into the office of chairman, to which he will succeed in the ordinary course of events at the next meeting of the division.

A. G. Trumbull, chief mechanical engineer of the Erie, was elected a member of the general committee to serve for the unexpired term of W. H. Fetner, deceasd.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.

American Railroad Master Tinner's Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.

Division V—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention Chicago, Sept. 7-9, 1927.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York. Annual meeting December 6 to 9.

American Society for Steel Treatment.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Birmingham Car Foremen and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting December 13. Paper on reclamation and conservation of material will be read by F. A. Starr, supervisor reclamation, Chesapeake & Ohio.

Car Foremen's Association of St. Louis.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August, Hotel Statler, Buffalo, N. Y. Next meeting, December 9. Paper on terminal improvements at Buffalo will be read by W. F. Jordan, engineering assistant to the president, New York Central.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention, Chicago, September, 1927.

Cincinnati Railway Club.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting December 6. Paper on the progress and possibilities in safety will be read by T. H. Carrow, supervisor of safety, Pennsylvania, and chairman, Safety Section, American Railway Association.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.

International Railway Fuel Association.—L. G. Plant Railway Exchange, 80 E. Jackson boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.

Louisiana Car Department Association.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt, St., New York. Annual meeting Chicago, May, 1927.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting December 14. Paper on automatic train control will be read by G. E. Ellis, secretary, American Railway Assn.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting, December 17. Annual dinner.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting December 9. History of the Santa Fe railroad will be presented by Lacy L. Galbraith.

Railway Club of Greenville.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 10. Paper on the start of the second century of modern transportation will be read by Col. Albert T. Perkins, manager for the receiver, United Railways of St. Louis. Christmas entertainment.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November.

Southeastern Carmen's Interchange Association.—C. Kimball, Inman shops, Southern, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Allen, Sproull & Allen, Fort Worth, Tex., will in the future represent the Bridgeport Company in the southwest.

The O'Malley-Beare Valve Corporation has opened a city sales office at 217 Railway Exchange building, Chicago.

The American Machinery & Equipment Company, Detroit, Mich., has moved its offices to 2532 Twenty-fourth street.

John Parker has been appointed New England representative of the Rollway Bearing Company, Inc., Syracuse, N. Y.

The Roto Company has removed its headquarters from Hartford, Conn., to Sussex avenue and Newark street, Newark, N. J.

The Lincoln Steel Company, Chicago, has moved its offices from 2320 West Fifty-eighth street to 229 West Illinois street.

Charles Elliott, general superintendent of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., died on October 26.

Patrick W. O'Brien, assistant general manager of sales of the Illinois Steel Company, died in Chicago on November 9 of pneumonia.

The Ohio Brass Company, Mansfield, Ohio, is constructing a five-story steel and brick office building, 52 ft. by 255 ft., to cost $500,000.

Mefford R. Runyon has been appointed district sales manager for the New York Metropolitan district of the Bridgeport Brass Company, Bridgeport, Conn.

James D. Robertson, president of the Warren Tool and Forge Company, Warren, Ohio, died on October 28 at Pittsburgh, Pa., following a stroke of apoplexy.

Frederick G. Lewis, vice-president and director of George B. Carpenter & Company, Chicago, died on October 29 at Wheaton, Ill., following a short illness.

Bruce Owens, who has been elected vice-president of the O'Malley Beare Valve Corporation, Chicago, as was announced in the October *Railway Mechanical Engineer*, was born in Maysville, Ky., on March 12, 1883. In 1901 he entered the employ of the J. W. Barrett Brass Foundry Company at St. Louis, Mo. This company was later taken over by the Hewitt Manufacturing Company, which later became a part of the Magnus Company, Inc. In 1910 he was appointed service engineer of the latter company and in 1917 was promoted to assistant to the vice-president. He held the latter position until February, 1922, when he was promoted to sales manager.

Bruce Owens

Walter F. Brumm, assistant district sales manager of the Inland Steel Company, with headquarters at Kansas City, Mo., has been transferred to St. Louis.

The Cleveland Punch & Shear Works Company, Cleveland, Ohio, has removed its Philadelphia, Pa., office from 321 Bulletin building to 1201 Pennsylvania building.

The Pyle-National Company, Chicago, has awarded a general contract to C. Rasmussen for the construction of a one-story foundry addition, 25 ft. by 160 ft., to cost $50,000, with equipment.

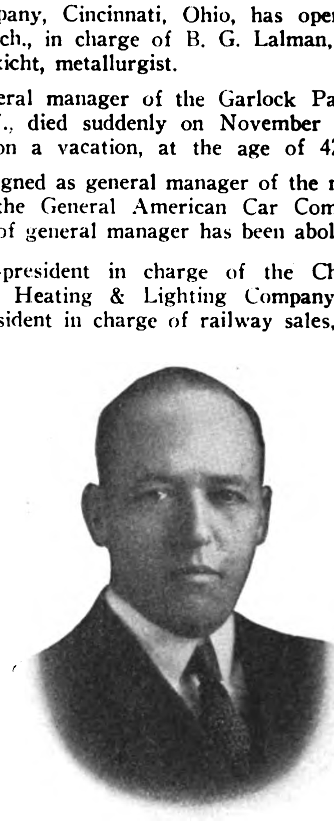
The Cleveland offices of the Central Alloy Steel Corporation and the United Alloy Steel Corporation have been combined and moved to 1716 Union Trust building.

The Pollak Steel Company, Cincinnati, Ohio, has opened a sales office at Detroit, Mich., in charge of B. G. Lalman, sales engineer, and W. R. Klinkicht, metallurgist.

Henry N. Winner, general manager of the Garlock Packing Company, Palmyra, N. Y., died suddenly on November 12 at Philadelphia, Pa., while on a vacation, at the age of 47.

Henry Donovan has resigned as general manager of the manufacturing department of the General American Car Company, Chicago, and the position of general manager has been abolished.

John H. Rodger, vice-president in charge of the Chicago office of the Safety Car Heating & Lighting Company, has been promoted to vice-president in charge of railway sales, with headquarters at New York. George H. Scott, representative at Chicago, has been promoted to manager of the Chicago office and Carl A. Pinyerd, for the past few years district engineer in the Chicago office, has been promoted to commercial engineer with the same headquarters. John H. Rodger began work in 1899 with the Standard Coupler Company, New York, leaving that service in 1905 to become assistant to the president of the Monarch Machine Company. He was then for a time engaged in other business and returned to the railway supply business in April, 1911, when he entered the service of the Safety Car Heating & Lighting Company, and was assigned to the Chicago office as a sales representative. Subsequently he served as acting vice-president and later as western manager until his appointment in June, 1922, as vice-president, with the same headquarters, which position he held until his recent promotion to vice-president in charge of railway sales, with headquarters at New York.



J. H. Rodger

Ernest Smith has been appointed sales engineer of the Allis-Chalmers Manufacturing Company at the office at Oruro, Bolivia, which is a sub-office of the district headquarters at Santiago, Chile.

J. E. M. Schultz, representative of the Sullivan Machinery Company, with headquarters at Nashville, Tenn., has been appointed manager of the office at Dallas, Texas, to succeed D. H. Huster, resigned.

G. G. Jones, manager of the Chicago office of the American Locomotive Company, has been appointed sales engineer and B. W. Parsons has been appointed sales representative at St. Paul, Minn., with office at 1010 Builders' Exchange.

The Whitman & Barnes Manufacturing Company, Akron, Ohio, and the Detroit Twist Drill Company, Detroit, Mich., have been consolidated under the name of Whitman Barnes-Detroit, Corporation, with headquarters at Akron.

E. F. O'Connor, airbrake foreman on the Southern, with headquarters at Birmingham, Ala., has resigned to become a representative in the southeastern territory for the Edna Brass Manufacturing Company, with headquarters at Richmond, Va.

The Positive Lock Washer Company, Newark, N. J., originator of Positive type lock washers has appointed the Lundie Engineering Corporation of New York and Chicago, as its exclusive railroad sales agents for the United States and Canada.

George W. Denyven has been appointed New England representative of the Tyler Tube & Pipe Company, Washington, Pa.

Mr. Denyven will have his headquarters at Boston, Mass. W. H. S. Bateman & Co., Philadelphia, Pa., have been appointed special representatives.

Norman C. Naylor, sales agent of the Railway Steel Spring Company, with headquarters in the Peoples Gas building, Chicago, has been appointed district sales manager of both the American Locomotive Company and the Railway Steel Spring Company, with headquarters in the McCormick building.

The Globe Railway Equipment Company, St. Louis, Mo., has placed a contract with the Larkin Engineering Company, St. Louis, for the construction of two concrete, brick and steel buildings at Veedersburg, Ind. One building will be one story, 60 ft. by 150 ft., and the other will be two stories, 60 ft. by 200 ft.

W. P. Steele, accessory sales manager of the American Locomotive Company, has resigned. Mr. Steele's career began in 1880 on the Boston & Maine. In 1901 he entered the employ of the Galena-Signal Oil Company, resigning in 1906 to become assistant to vice-president of the American Locomotive Company. In 1912, he was promoted to assistant to president; in 1917, Chicago representative, and in 1919, sales manager of Alco accessories.

James B. Sipe & Co., Pittsburgh, Pa., manufacturers of Japan oils and paints for railroads, recently placed a contract with the Austin Company, New York, for a two-story addition, 60 ft. by 180 ft., to their plant at Bridgeville, Pa. They have appointed the following district managers of the railroad and car department: A. W. Fields, 640 Equitable building, St. Louis, Mo.; G. W. Lindholm, 125 West Forty-sixth place, Chicago; John H. McCartney, 165 Broadway, New York City. D. B. Vail, who has represented the company for fifteen years, continues as manager of the railroad and car department.

Cincinnati Grinders, Incorporated, Cincinnati, Ohio, has been incorporated recently with an authorized capital of $1,500,000 common stock and has succeeded to the grinding machine business of the Heim Grinder Company, Danbury, Conn., and the Cincinnati Milling Machine Company, Cincinnati. The manufacture of the Heim centerless and the Cincinnati plain, universal and centerless grinders will be continued as heretofore, and early in 1927 will be united in a modern plant at Cincinnati. The new company has acquired the Triumph Electric plant at Oakley, Cincinnati, and will convert this property into a modern and well equipped grinding machine plant. The new plant is expected to be in operation early in 1927 and will commence operations with a force of several hundred men. P. O. Geier is president of the new company, George W. Binns, secretary, and F. M. Angevin, formerly of the Heim Grinder Company, treasurer. The directors include R. C. W. Harrison, formerly grinding machine engineer of Churchill Machine Tool Company, Manchester, England, and C. Booth, formerly works manager of Heim Grinder Company, and previously engineer of the Heald Machine Company.

Union Switch & Signal Company acquires right to use Miller train control

A joint agreement has been entered into between the General Railway Signal Company, the Union Switch & Signal Company and the Miller Train Control Corporation whereby the two signal companies acquire the right to manufacture and sell the Miller train control systems and train-stop devices in the United States, east of the Rocky mountains, and also in the Dominion of Canada.

The General company had previously obtained a license from the Miller company, it being stated that the Miller organization would remain intact and had reserved the Chicago & Eastern Illinois, the Elgin, Joliet & Eastern and the Toledo-Detroit division of the New York Central. The new agreement provides for the same conditions. It is understood that the Miller engineers will co-operate with the engineering departments of both signal companies. Since the agreement was first made with the General company, the Miller engineers have been working with the engineering department of that company in designing and perfecting plans for effecting interchangeability and standardization, and this work is now well in hand.

Trade Publications

McCrosky tools.—Price lists and specifications for the McCrosky line of reamers, quick change chucks and collets, engine lathes, etc., are contained in Catalogue No. 10 of the McCrosky Tool Corporation, Meadville, Pa.

Vertical slide tool.—A vertical slide tool for boring an internal recess 1¾ in. long and 1/64 in. deep, is illustrated and described in a four-page folder being distributed by the Warner & Swasey Company, 7501 Carnegie avenue, Cleveland, Ohio.

Motorized power.—A 12-page bulletin illustrating G-E motorized power (electric locomotives, electric tractors and trucks, cranes and handling equipment) in actual use, has been issued by the General Electric Company, Schenectady, N. Y.

Railway appliances.—The Morton Manufacturing Company, 5105 West Lake street, Chicago, is preparing for distribution early in January a new catalogue covering all of the items included in the Acme line of railway appliances and industrial steel products.

Lead base babbitting.—Folder No. 4474 describing the babbitting of bearings and explaining the use of the Westinghouse automatic electric babbitting pots, has been prepared by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Lo-Hed hoists.—The American Engineering Company, Philadelphia, Pa., has prepared a 42-page catalogue descriptive of the Lo-Hed electric hoist. The wide range of lifting and handling conditions under which the hoist operates, is shown in numerous illustrations.

Riveters.—Hanna riveted cars and locomotives and steel bridges are illustrated in the 12-page booklet prepared by the Hanna Engineering Works, 1765 Elston avenue, Chicago. A brief description of the different types of Hanna riveter is also contained in the booklet.

Unit heaters.—The various types and applications of Buffalo unit heaters are described in catalogue No. 466 issued by the Buffalo Forge Company, Buffalo, N. Y. These heaters are for use in warehouses, freight sheds, depots, machine shops, foundries and other industrial plants.

Standard Tools for Small Turret Lathes.—Standard tools for small turret lathes of any make are described in an attractive catalogue, No. MH-2A, issued by the Gisholt Machine Company, Madison, Wis. The catalogue is both alphabetically and numerically indexed.

Silent gears.—Publication GEA-482 of the General Electric Company, Schenectady, N. Y., describes Fabroil and Textolite silent gears designed to eliminate continuous loud noise and the vibrations and shocks transmitted to the driven machines by gear trains running at high speed.

Centrifugal pumps.—The Ingersoll-Rand Company, 11 Broadway, New York, is distributing the second edition of Form No. 7059 descriptive of the Cameron single-stage, double-suction, volute centrifugal pumps suitable for direct connection to alternating or direct current motor, steam turbine, gasoline engine, or for belt drive.

Superheated steam pyrometers.—The Model 496 pyrometer for superheater locomotives is described in the third edition of the instruction book on superheated steam pyrometers which has been prepared by the Superheater Company, 17 East Forty-second street, New York. Instructions for the installation, operation and maintenance of the pyrometer, and a convenient list of parts are given in the book.

General catalogue.—The Ohio Brass Company, Mansfield, Ohio, is distributing catalogue No. 20, completely listing all O-B porcelain insulators, trolley and line materials, rail bonds, car equipment and mining materials. Signal bonds and other special products of interest to the signal departments of steam railroads are grouped in one section of the catalogue, and there is a comprehensive listing of automatic car couplers, including electric and air connections, suitable for electrified terminal zones.

Personal Mention

General

J. W. WOMBLE, mechanical superintendent of the Midland Valley, with headquarters at Muskogee, Okla., has also been appointed mechanical superintendent of the Kansas, Oklahoma and Gulf.

F. F. McCARTHY has been appointed district superintendent of motive power of the New York Central, with headquarters at Elkhart, Ind., with jurisdiction over the Fourth district, succeeding W. R. Lye.

N. J. BOUGHTON, mechanical engineer of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to engineer of tests, with the same headquarters, succeeding C. L. Buckingham, deceased.

Master Mechanics and Road Foremen

C. G. Goff has been appointed master mechanic on the Southern, with headquarters at Birmingham, Ala.

L. C. SHULTS has been appointed master mechanic on the Southern, with headquarters at Atlanta, Ga.

O. SMALL has been appointed master mechanic on the Southern, with headquarters at Alexandria, Va., succeeding A. M. Lawhon.

W. H. KELLER has been appointed master mechanic of the Louisiana & North West, with headquarters at Homer, La., succeeding J. T. Simpson, resigned.

WILLIAM F. BUSCHER, general master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie at Minneapolis, Minn., was shot while in his office at Shoreham yards, Monday, November 22. The assailant had been discharged from his duties as a fireman last May, and had returned to Minneapolis seeking reinstatement. Being refused by Mr. Buscher, he fired three shots two of the bullets taking effect in Mr. Buscher's arm and thigh.

H. C. TREXLER, shop superintendent of the Southern at Spencer, N. C., has been appointed master mechanic of the Ferguson shops at Somerset, Ky. Mr. Trexler was born on January 3, 1894, in Rowan County, N. C. He attended an academy at Salisbury, N. C., and on August 14, 1909, entered the service of the Southern as a machinist apprentice at Spencer. He finished his apprenticeship in December, 1913, and until May, 1919, was employed as a machinist. He was then promoted to foreman machine shop, and in April, 1920, promoted to foreman erecting shop. In June, 1924, he became shop superintendent at Spencer.

Car Department

P. J. CUMMINGS, foreman car inspector of the Missouri Pacific, has been promoted to general car foreman, with headquarters at Alexandria, La.

Shop and Enginehouse

T. C. CARTER, general foreman of the Illinois Central at Vicksburg, Miss., has been transferred to Monroe, La.

W. R. BRYAN, roundhouse foreman of the Illinois Central at Monroe, La., has been transferred to Shreveport, La.

W. M. KELLEY, locomotive inspector of the Illinois Central at Monroe, La., has been promoted to night roundhouse foreman.

G. E. BELL, machinist, has been promoted to day roundhouse foreman of the Illinois Central, with headquarters at Monroe, La.

Purchases and Stores

J. F. NEWMAN, storekeeper of the Pennsylvania, with headquarters at Pitcairn, Pa., has been transferred to Pittsburgh, Pa., succeeding W. C. Livingston, who has been assigned to Mr. Newman's former place at Pitcairn.

R. F. HOMER has been appointed acting assistant storekeeper on the Pennsylvania at Altoona, Pa., succeeding W. W. Shugarts.

W. W. SHUGARTS has been appointed storekeeper on the Pennsylvania at Altoona, Pa., succeeding H. R. Wood, relieved on account of illness.

C. B. SAULS, division storekeeper on the Illinois Central, with headquarters at McComb, Miss., has been appointed storekeeper of the Gulf & Ship Island in addition to his present jurisdiction.

J. C. NEPH, assistant district storekeeper, on the Southern Pacific, at El Paso, Tex., has been promoted to general inspector of stores and supply train service, with headquarters at San Francisco, Cal., succeeding J. C. Neph.

FREDERICK I. PLECHNER, assistant purchasing agent on the Great Northern, at St. Paul, Minn., has been promoted to purchasing agent, with the same headquarters, succeeding Fred A. Bushnell, resigned. Mr. Plechner was born on February 8, 1871, at St. Paul. He graduated from the St. Paul High School in the class of 1889. Prior to entering railway service he was traveling representative in Oregon, Washington and Idaho for a wholesale and manufacturing firm, with headquarters at St. Paul. His connection with railroad work began on December 1, 1913, when he was appointed assistant purchasing agent on the Great Northern at St. Paul. Mr. Plechner now has jurisdiction over the entire purchasing and stores department of the Great Northern.

Frederick I. Plechner

Obituary

HOWARD M. CURRY, formerly general mechanical superintendent of the Northern Pacific at St. Paul, Minn., died on November 23. Mr. Curry, until his retirement in 1923, had been an employee of the Northern Pacific for forty-three years. He was born on January 6, 1861, in Ogle County, Ill., and entered railway service in April, 1880, as a shop man and locomotive fireman on the Northern Pacific, being promoted to locomotive engineer in July, 1882. He was promoted to assistant road foreman of engines of the lines east of the Missouri river on December 1, 1891, and in December, 1898, was promoted to road foreman of engines. He became division master mechanic at Fargo, N. D., in November, 1901, and was transferred to Staples, Minn., in December of the following year. He was appointed general master mechanic of the lines east of Billings, Mont., in February, 1905, and in January, 1908, was given extended duties as general master mechanic to include the lines east of Paradise, Mont. In January, 1910, he became general master mechanic of the lines east of the Missouri river; in May, 1911, mechanical superintendent, and in August, 1920, general mechanical superintendent.

Howard M. Curry